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THE UNIVERSITY OF ALBERTA

CANADIAN REGIONAL INEQUALITY: THE PROCESS OF ADJUSTMENT

by

ROBERT L. MANSELL

A THESIS

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ABSTRACT

The objective of this thesis is to reconcile the observed patterns of long-run regional wage and per capita income inequality in Canada with the predictions of most economic theories of regional adjustment. These theories involve adjustments through one or a combination of interregional flows of goods, people or funds and generally predict a convergence of regional wage rates, at least up to some constant differential representing mobility costs. Given that the per capita income inequality across Canadian regions is largely due to regional wage inequality, this predicted wage convergence should mean some convergence of per capita incomes. An analysis of Canadian regional inequality indicates however, that not only is the degree of regional income inequality severe in comparison to that observed in other industrialized countries, but also there appears to be little long-run change in the level of inequality over the considerable period of time for which data exist. This general lack of change is observed over a period in which there were large variations across regions in rates of development and growth, and increasing efforts by the federal government to reduce regional disparities. This evidence, along with an analysis of long-run trends in regional inequalities in wages and employment bases, suggests that Canadian regional inequality can be plausibly interpreted as a long-run equilibrium level of inequality.

A dynamic model of regional wage adjustment incorporating both interregional factor and commodity movements is presented and a numerical analysis to determine its properties is undertaken. It is shown that the model produces a steady-state equilibrium level of regional wage inequality and that this equilibrium level generally exceeds that predicted by static models of adjustment. It is also shown that under certain conditions, shocks corresponding to variatons in regional growth rates and government equalization policies have little effect on the equilibrium level of wage inequality produced by the model. The model is applied to the special cases of Alberta and Nova Scotia and it is found that it is confirmed to a high degree by the data. Hence, it is suggested that, at least for these two regions, the lack of significant long-run change in wage inequality can be explained by the same interactions and adjustments as embodied in the model. Finally, on the basis of the results of a numerical analysis of the model and various tests of hypotheses it is concluded that the long-run differences in wage levels between these two regions are primarily due to differences in average levels of productivity and differences in labor mobility to or from the regions.

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CHAPTER I

INTRODUCTION

1.1 THE NATURE OF CANADIAN REGIONAL INCOME INEQUALITY

In many countries a common circumstance is the existence of sharp disparities in the fortunes of regions within the country. This phenomena, commonly referred to as the "North-South" problem, has been observed in countries at all levels of development and at all levels of affluence. Canada is no exception in this respect. The existence of large regional variations in economic activity has been documented for a significant part of Canada's history.[1]

A salient characteristic of the Canadian regional problem is its severity in relation to that in other industrialized countries.[2] Williamson's study,[3] for example, indicates that of the six countries in Kuznet's Group I (the highly developed countries) Canada has, in terms of an unweighted index[1] of regional disparities, the most severe problem. A number of international comparisons based on an unweighted coefficient of variation[2] are provided in Table 1.1.1.

---

[1] For example, see Marvin McInnis, "The Trend of Regional Income Differentials in Canada," Canadian Journal of Economics, 2 (May, 1968), pp. 440-470, and Alan G. Green, Regional Aspects of Canada's Economic Growth, (Toronto: University of Toronto Press, 1971).

[2] The evidence on regional inequality for many countries has been analyzed and summarized in Jeffrey G. Williamson, "Regional Inequality and the Process of National Development: A Description of Patterns," Economic Development and Cultural Change, 12, Part II, (July, 1965), pp. 3-45. Two very thorough studies of regional inequality in the United States are: Richard A. Easterlin, "Interregional Differences in Per Capita Income, Population and Total Income, 1840-1950, Trends in the American Economy in the Nineteenth Century, (Princeton: Princeton University Press, 1960), pp. 73-140 and Frank A. Hanna, State Income Differentials, 1919-1954, (Durham, N.C.: Duke University Press, 1959).

[3] Ibid., p. 12.

TABLE 1.1.1

UNWEIGHTED INDEXES OF REGIONAL INEQUALITY (V_{uw}) FOR SELECTED COUNTRIES (Based on 1950-1960 data)

Kuznet's Group	Country	V_{uw}
I	Canada	.259
I	United States	.189
I	Sweden	.168
I	United Kingdom	.156
I	New Zealand	.082
I	Australia	.078
Group I Average		.155
II	Finland	.276
II	Norway	.253
II	France	.215
II	W. Germany	.205
II	Netherlands	.128
Group II Average		.215

Source: Jeffrey G. Williamson, "Regional Inequality and the Process of National Development: A Description of Patterns," Economic Development and Cultural Change, 12, Part II, (July, 1965), p. 12.

---

[1] That is, unweighted with respect to the relative population size of each of the regional units.

[2] This index is defined as:

$$V_{uw} = \sqrt{\frac{\sum_{i=1}^{N} (y_i - \bar{y})^2}{N-1}} \Big/ \bar{y} \; ;$$

where N = number of regions, y_i = income per capita in the ith region, and $\bar{y}$ = national income per capita.

Perhaps the most striking feature of Canadian regional inequality, however, is the lack of substantial change in the degree of regional income inequality over the long period for which data exists. Williamson concludes that:

> Canada does not reveal any significant trends toward either divergence or convergence during the thirty-five year period, 1926-60.[1]

The McInnis study[2] reaches the same conclusion for the period 1910-1962, and suggests that this observed long-run constancy may in fact represent some kind of long-run equilibrium. In addition, Green's[3] study of Canadian regional inequality suggests that existing levels of inequality can be traced back to at least the period 1890-1929.

Another characteristic of Canadian regional inequality is that regional wage inequality appears to be the single most important factor in per capita income inequality. An analysis of income disparities by Chernick,[4] for example, indicates that roughly three-fifths of regional per capita income differentials is due to regional wage differentials, with the residual due primarily to regional differences in manpower utilization. Moreover, existing research on the rather large interregional differences in earnings, although incomplete and analytically deficient, indicates that only a small part of these differences is accounted for by the more obvious factors such as regional differences in industrial structures and rural-urban distributions. Denton,[1] for example, after attempting to account for the observed regional differences in earnings by differences in industrial and occupational distributions, age composition, hours and weeks of work, average levels of education and rural-urban population distributions, concludes:

---

[1] Williamson, "Regional Inequality," p. 30.

[2] McInnis, "The Trend of Regional Income Differentials in Canada," p. 448.

[3] Alan G. Green, "Regional Aspects of Canada's Economic Growth, 1890-1929," Canadian Journal of Economics and Political Science, 33, (May, 1967), pp. 232-245.

[4] S.E. Chernick, Interregional Disparities in Canada, Staff Study 14, Economic Council of Canada, (Ottawa: Queen's Printer, 1966), p. 26.

> . . . even at the level of mere statistical distributions, the factors examined do not account for much of the observable variation in earnings; something more basic must be sought.[2]

A final characteristic of Canadian regional inequality which is relevant to this study is that just as with per capita income inequality there appears to be no substantial change in the degree of inequality in earnings per worker over the period for which data are available. In addition, as will be shown in Chapter II, this particular trend is not a result of offsetting changes in the earnings positions of the various regions. Rather, it is almost entirely due to a long-run constancy in the relative regional earnings positions.

1.2 THE PROBLEM

The above mentioned characteristics of Canadian regional inequality appear to be inconsistent with basic economic theory which predicts that wage rates will be equalized, at least up to some constant representing mobility costs, across regions. Since this tendency is not evident in Canada it would appear that either the types of adjustments embodied in the theories have not taken place, or else they have been insignificant. If the observed Canadian trends are evidence of a lack of adjustment, however, there is a problem of explaining how the observed long-run trends have been maintained in spite of large regional differences in rates of development and growth, and explicit government policies to reduce regional disparities. Clearly this situation would seem to indicate a quite efficient adjustment. In short, the problem is to explain the observed Canadian trends in regional earnings and income inequality within the framework of economic theory. The two aspects of the problem are outlined in more detail in the following paragraphs.

---

[1] Frank T. Denton, An Analysis of Interregional Differences in Manpower Utilization and Earnings, Economic Council of Canada Staff Study No. 15, (Ottawa: Queens Printer, 1966).

[2] Ibid., p. 13.

The economic theories relating to adjustments in regional inequalities generally rely on adjustments through interregional flows of people, goods or funds.[1] These theories are generally of two basic types - those which, among other things, assume free commodity trade with factor immobility and those which assume factor mobility with or without free commodity trade. The most widely acknowledged theory of the first type is the Heckscher-Ohlin theory of international trade. On the basis of this theory, Samuelson[2] proved that given certain assumptions factor price equalization would result from trade in the absence of factor movements. Now if this theory is carried to the special case of interregional trade,[1] one would expect factor price equalization across regions. This in turn would mean a convergence of regional earnings per worker and per capita incomes, since such income differences in Canada are largely due to differences in factor earnings. Although there is evidence that interregional trade in Canada is highly efficient,[2] there does not appear to be any significant narrowing in regional inequalities.

---

[1] These are outlined in Chapter III.

[2] P.A. Samuelson, "International Trade and the Equalization of Factor Prices," Economic Journal, 58, (June, 1948), pp. 163-184.

An example of the second basic type of theory has been provided by Mundell.[3] Basically he showed that (given certain assumptions) in a situation where there is perfect factor mobility but restricted commodity mobility and any initial difference in factor prices, factors would move in such a way as to equalize factor prices and commodity prices, and eliminate further factor movements. This prediction is also consistent with that of most partial equilibrium models (which may or may not require free commodity trade). Most of these types of models operate within the framework of Marginal Productivity Theory. They generally view labor and capital as seeking their highest return by moving in opposite directions; labor flowing to the high-wage region and capital flowing to the high-return region. These flows tend to raise the capital-labor ratio and hence the marginal productivity of labor and thus the real wage in the low wage region, and in a similar manner tend to depress the real-wage in the initially high-wage region. In this way, regional wage equalization is brought about.

---

[1] See J.R. Moroney and J.M. Walker, "A Regional Test of the Heckscher-Ohlin Hypothesis," Journal of Political Economy, 74, (Dec., 1966), pp. 573-586. There, in addition to arguing that the Heckscher-Ohlin theory is in some respects more realistic for interregional than international trade, (for example because there are no tariff barriers to interregional trade, and demand patterns are similar across regions), they provide some tests which lend support to such a theory of interregional trade.

[2] See Wayne Thirsk, Regional Dimensions of Inflation and Unemployment, Research Report prepared for Prices and Incomes Commission (Ottawa: Queen's Printer, 1973), pp. 36-37. There he shows a very high correlation between regional price changes in traded goods.

[3] R.A. Mundell, "International Trade and Factor Mobility," American Economic Review, 47, (June, 1957), pp. 321-335.

While there is a lack of research on the direction of regional capital flows in Canada[1] there has been a significant amount of work on interregional labor migration.[2] The latter provides conclusive evidence that such migration is in the right direction (that is, from low-wage to high-wage regions). It must also be noted at this point that even if capital movements are not in the right direction, such labor migration should (within the above theoretical context) produce a levelling in regional inequality so long as perverse capital movements are not overwhelming in relation to the labor movements. In any case, given the continued and rather substantial interregional migration flows in Canada it is sometwhat surprising that there has not been a significant decrease in regional wage and income disparities. Perhaps even more puzzling about this lack of convergence is that the important elements of both basic types of theories are met in the Canadian case; not only is there a high degree of interregional factor mobility but also essentially free interregional trade.

---

[1] What little evidence there is on the direction of regional capital flows in Canada is consistent with the hypothesis that capital tends to flow from the high income regions to the low income regions. See, for example R.E. George, A Leader and a Laggard Manufacturing Industry in Nova Scotia, Quebec and Ontario (Toronto: University of Toronto Press, 1970) and Canadian Bankers Association; The Banks and the West, brief presented to the Western Economic Opportunities Conference, (July, 1973).

[2] See for example, T. Courchene, "Interprovincial Migration and Economic Adjustment," Canadian Journal of Economics, III, (November, 1970), pp. 550-576 and C. Laber and R.X. Chase, "Interprovincial Migration in Canada as a Human Capital Decision," Journal of Political Economy, 79, (August, 1971), pp. 795-804.

Part of the problem to be dealt with in this study involves explaining how the observed wage and income inequality in Canada could have been maintained over time particularly when there have been large differences in regional rates of development and growth. Perhaps the best indicator of such differences is the change over time in the regional distribution of the national population. The percentage changes in the provincial populations over the period 1901-1971 are presented in Table 1.2.1. It is evident that not only have there been substantial differences among the regions in overall rates of growth over the period 1901-1971, but also that there have been considerable variations in growth rates for individual regions over this period. Saskatchewan, for example, had a 440 per cent increase in population over the period 1901-1911 and a 7 per cent decrease over the period 1941-1951. Many of these changes in regional growth rates are associated with such developments as the settlement of the Prairies, the decline in the competitive position of the coal and steel industry in Nova Scotia, and the discovery of oil in Alberta.

Further, the lack of significant convergence of Canadian regional earnings and incomes has been observed over a period in which there have been continually increasing efforts by governments (particularly over the post-war period) to reduce regional disparities. For example,

TABLE 1.2.1

PERCENTAGE CHANGES IN PROVINCIAL POPULATIONS FOR DECENNIAL CENSUS YEARS, 1901-1971

(% Change Between Census Years)

	1901-11	1911-21	1921-31	1931-41	1941-51	1951-61	1961-71	1901-71
Newfoundland	9.8*	8.4*	7.0*	7.7*	19.0*	10.3	14.0	136.2
Prince Edward Island	-9.2	-5.5	-0.7	8.0	3.6	5.4	6.7	8.7
Nova Scotia	7.1	6.4	-2.1	12.7	11.2	6.1	7.1	71.5
New Brunswick	6.3	10.2	5.2	12.0	12.7	7.8	6.2	91.8
Quebec	21.6	17.7	21.8	15.9	21.7	13.6	14.6	265.6
Ontario	15.8	16.1	17.0	10.4	21.4	15.4	23.5	252.9
Manitoba	80.8	32.2	14.8	4.2	6.4	8.4	7.2	287.5
Saskatchewan	439.5	53.8	21.7	-2.8	-7.2	5.1	.1	917.6
Alberta	412.6	57.2	24.3	8.8	18.0	18.6	22.2	2130.1
British Columbia	119.7	33.7	32.3	17.8	42.5	16.5	34.1	1120.7
Canada	34.2	21.9	18.1	10.9	21.8	13.4	18.3	301.6

*Based on Estimated Population.

Source: Based on data in Dominion Bureau of Statistics, Canada Year Book, 1962, (Ottawa: Queen's Printer, 1962), p. 1196 and Dominion Bureau of Statistics (Statistics Canada), Vital Statistics, various issues, (Ottawa: Queen's Printer), Cat. 84-202.

fiscal equalization payments to the provinces have risen steadily over the post-war period (see Table 1.2.2), and by 1971 amounted to more than one billion dollars annually. These payments now amount to as much as 65 per cent of provincial tax revenues from provincial sources.[1]

In addition to these expenditures, federal government expenditures on regional development have shown a steady increase, rising from 0.7 per cent of total expenditures on government services in 1963 to about 2.6 per cent in 1973.[2] These expenditures are now made by the Department of Regional Economic Expansion (DREE) and involve many types of programs, the majority of which are aimed at reducing regional disparities. These programs include Regional Development Incentives (RDIA), Special Areas, Agricultural Rehabilitation and Development (ARDA), Prairie Farm Rehabilitation (PFRA), Fund for Rural Economic Development (FRED), and those under the Cape Breton Development Corporation. The total cumulative commitments (excluding guaranteed loans) to industrial incentives, (under the Area Development Act and RDIA) as of January 1972 amounted to more than $270 million, while infrastructural assistance in special areas had by the same time reached more than $100 million.[3]

---

[1] Canadian Tax Foundation, National Finances, 1972-73, (Toronto: 1972), Ch. 10.

[2] Ibid., p. 75.

[3] Canadian Tax Foundation, National Finances, 1972-73, (Toronto: 1972), pp. 148-150.

TABLE 1.2.2

EQUALIZATION PAYMENTS TO THE PROVINCES FOR FISCAL YEARS ENDING 31 MARCH, 1958-1971

($ MILLION)

	Nfld.	P.E.I.	N.S.	N.B.	Que.	Ont.	Man.	Sask.	Alta.	B.C.	Total
1958	11.6	3.0	17.4	8.6	43.1	---	13.9	19.2	14.7	4.5	136.0
1959	12.2	3.1	15.6	8.7	55.0	---	12.9	19.9	8.0	8.2	143.4
1960	14.3	3.0	20.7	16.9	68.6	---	13.0	20.2	15.1	11.3	183.0
1961	15.4	3.5	21.0	17.4	70.4	---	14.1	23.7	17.5	5.9	188.9
1962	11.2	2.8	18.2	16.0	62.6	---	11.9	21.2	14.9	5.9	164.7
1963	13.5	3.1	19.5	15.5	77.8	---	15.2	27.6	8.1	-3.7	176.6
1964	15.0	3.8	19.1	16.5	70.2	---	13.6	22.4	6.8	---	167.4
1965	18.4	5.5	26.2	22.9	103.1	---	21.6	24.1	4.8	---	226.6
1966	22.2	6.0	35.5	35.7	125.2	---	25.3	26.7	.5	-2.1	275.0
1967	29.0	7.2	41.6	35.1	155.5	---	32.6	34.3	.3	- .2	335.5
1968	65.2	13.6	70.6	62.2	229.4	---	41.0	21.9	1.6	---	505.4
1969	72.7	14.2	83.6	74.9	284.0	---	40.4	18.8	---	---	588.7
1970[a]	86.0	16.9	90.0	83.1	343.1	---	42.1	12.3	---	---	673.5
1971[a]	89.8	21.6	88.7	82.1	517.8	---	39.7	40.0	---	---	879.8[b]

[a] Estimate, [b] Revised calculation brings total to $975 million.

Source: Canadian Tax Foundation, National Finances 1970-71, (Toronto: 1970), p. 151.

1.3 AN OVERVIEW

It is in light of the above mentioned factors that the long-run nature of Canadian regional inequality is investigated in this thesis. Chapter II begins by outlining some basic methodological considerations and summarizing the existing research on the trends in Canadian regional income inequality. Following this, an analysis of the long-run trend in regional income inequality in Canada over the periods 1926-1971, and 1949-1971 is presented. This analysis takes account of several possible shortcomings of previous analyses and is specifically designed to assess the plausibility of a "long-run equilibrium" interpretation of Canadian regional inequality. It is shown that any levelling there might have been over these periods is slight and almost entirely due to a fall and rise respectively in British Columbia's and Newfoundland's relative per capita income positions. The latter part of Chapter II is devoted to summarizing existing research on factors associated with Canadian regional inequality and analyzing the long-run trends of some of these factors. There it is shown that much the same patterns hold with respect to trends in regional disparities in earnings per worker and the percentages of the population employed as trends in per capita income disparities. There has been a remarkable long-run stability in the relative positions of the regions in terms of these two variables. On the basis of previous research which indicates the importance of earnings inequalities in regional income inequalities and the trends established in Chapter II, attention is focused on explaining the long-run pattern of regional wage inequality in Canada.

In Chapter III, a summary of the theoretical aspects of regional wage adjustment is presented. After critically discussing various models applicable to regional wage adjustment and their relation to the problem set out in this study, it is concluded that existing models are unsatisfactory from the point of view of reconciling the observed trends in regional wage inequality with economic theory. For the most part these models involve a static type of analysis and are based on extremely rigid and unrealistic assumptions.

On the basis of this summary and critique of existing models, a dynamic and more realistic model of regional wage adjustment is presented in Chapter IV. In analyzing the characteristics of this model it is found that even with interregional commodity and factor mobility there does not necessarily have to be an equalization of regional wages, even up to some constant representing mobility costs. In fact, this model produces a steady state equilibrium regional wage differential, the level of which is related to factors such as the responsiveness of interregional migration to per capita income differentials and generally exceeds that predicted by static models. Further, in the steady state equilibrium produced by the model there is continuous adjustment (that is, constant interregional factor and commodity flows over time). It is worth noting here that if the observed Canadian patterns are viewed as constituting a long-run equilibrium of the type produced by static models (that is, where the equilibrium wage differential equals mobility costs) then interregional factor movements should be approaching zero. This latter tendency is not observed in the Canadian case.

In Chapter V this model of regional wage adjustment is applied to the cases of Nova Scotia and Alberta. There it is indicated that the observed constancy over time in the relative wage levels in Alberta and Nova Scotia can plausibly be interpreted as a long-run equilibrium of the type produced by the model. It is also shown that the differences in the relative earnings positions of Alberta and Nova Scotia can be explained by differences between the two regions in production and migration equations.

Finally, Chapter VI provides a general summary of the results of this study and a brief discussion of policy implications and directions for further research.

CHAPTER II

AN ANALYSIS OF LONG-RUN TRENDS IN CANADIAN REGIONAL INEQUALITY

2.1 INTRODUCTION

The main purpose of this chapter is to up-date some of the existing research on trends in Canadian regional inequality and determine, given recent experience and a slightly different approach, whether the long-run trend in regional inequality is one of convergence, divergence, or constancy. A brief summary and critique of existing research on these long-run trends precedes the various analyses of trends in regional inequality. In the analyses presented here attempts are made to remove the major criticisms levelled against this existing research. Particular attention is paid to determining whether the trends for individual regions indicate some type of long-run equilibrium. In addition, an attempt is made to evaluate the extent to which there have been any long-run changes in factors associated with regional income inequality. The emphasis here is on the long-run trends in regional inequality in employment bases[1] and earnings per worker. Before outlining the main results of this research some basic methodological elements are discussed.

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[1] The regional employment base is defined as the percentage of the regional population which is employed.

2.2 METHODOLOGY

2.2.1 MEASURING REGIONAL INEQUALITY

Regional inequalities or disparities can be defined with respect to a multitude of economic variables. The appropriate definition however will largely be determined by the nature of the inquiry. In this chapter the focus will be limited to two aspects of regional inequality - that concerned with regional differences in average levels of welfare, and that concerned with differences in levels of regional activity. From the first point of view the emphasis is on income received in a region while from the latter point of view the emphasis is on income produced in a region. The main reason for this particular distinction is that if one is interested in studying standard economic market adjustments in regional wages and incomes (as distinct from studying the effectiveness of government policies to reduce regional disparities in welfare) it is important to remove exogenous adjustments such as central government equalization transfers.

The usual proxy for the level of regional welfare is "personal income per capita" or "personal disposable income per capita." These income series are included in the National Accounts on a current dollar basis for the years 1926-1973. The main advantages of using the National Accounts income series are: (i) they are available on an annual basis for a long period of time,and (ii) they are provided on a suitable regional breakdown; in this case by province.[1] The main alternative to the National Accounts data are the Census data, but they are deficient in several important respects. In addition to excluding farm families in the Census survey the data may include a response bias. Most important of all however, most sections of this study require annual data while Census data are available on at best a five year basis.

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[1] See section 2.2.3.

Several criticisms can be levelled against the use of income per capita as an indicator of regional welfare. Abouchar[2] argues that household rather than per capita income should be used when making regional comparisons since in general there are certain economies of scale in household expense. Further, he argues that in order to make such comparisons regional income statistics must be adjusted for regional differences in income distributions, price levels, consumer debt patterns, intermediate goods like automobiles and urban services, housing imputation procedures and imputation procedures used for income in kind (other than housing). After attempting these kinds of adjustments he finds that for one year the spread from the lowest to highest income province narrows from about 70% on a per capita basis to about 28% on a per household basis.

While a similar set of adjustments to a long-run income series would be particularly interesting they are impossible due to

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[1] Alan Abouchar, "Regional Welfare and Measured Income Differentials in Canada," reprint series of Institute for Qualitative Analysis of Social and Economic Policy, University of Toronto, (December, 1971).

the paucity of regional data. Thus, even if one accepts that such adjustments are justified it is impossible to determine how regional inequalities in real levels of welfare have behaved over time.

An important shortcoming inherent in using the income per capita series as a proxy for regional welfare is that the figures are available only in current values. Thus it is possible that due to regional differences in prices the level of inequality in real income per capita is substantially different from that in current income per capita. In fact it has been argued by Coelho and Ghali[1] that when differences in regional price levels are taken into account the problem of regional disparities in the United States virtually disappears. These authors found that while the money wage differed by about 12.5% between the North and South United States, the North-South real wage differential was found to be insignificantly different from zero. It is thus suggested that it may be invalid to make regional comparisons on the basis of current income per capita.

Although price indexes are not available on a regional basis from Statistics Canada a set of proxy indexes has been calculated. S.E. Chernick[2] used price indexes for major regional cities to construct a set of regional consumer price indexes. Basically, he evaluated a common market basket (covering about two thirds of the items in the normal CPI) in each of 12 regional cities as of January 1963 and then extended each of the price series through time by using the published consumer price indexes for each regional city.

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[1] Phillip R.P. Coelho and Moheb A. Ghali, "The End of the North-South Wage Differential," American Economic Review, 61, (December, 1971), pp. 932-937.

[2] S.E. Chernick, Interregional Disparities in Income, pp. 47-51.

While such a series is useful as a first approach it has some rather fundamental flaws which could bias regional comparisons. First, the basket of goods and services upon which the index is based excludes shelter which accounts for around 18% of the consumer basket and which varies widely in cost across regions.[1] Secondly, there may be biases incorporated through the assumption that average prices in metropolitan centres accurately reflect average prices in the province as a whole. This bias could be significant if there are large differences in the cost of living between large urban areas and small urban and rural areas since there are substantial variations across provinces in the rural-urban distribution of the population.

If it is accepted that Chernick's regional price indexes are at least indicative of regional price variations, however, they can be used to show the welfare bias of current income per capita figures. When real income per capita computed on this basis is compared to current income per capita,

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[1] On the basis of Canadian Real Estate Association housing surveys, average house prices in 1973 varied between $19,056 in Saskatoon to $41,264 in Toronto. Note, however, the possibility that such differentials may in part reflect differences in tastes, quality and size. See Canadian Real Estate Association, Multiple Listing Survey, reported in The Calgary Herald, (November 8, 1973).

> . . . there is some deterioration in the position of the lower-income provinces in the interregional distribution of personal income . . .[1]

This evidence suggests that current income figures will tend to underestimate the severity of regional welfare disparities. Furthermore, upon deflating the current income series with the proxy price indexes Chernick found that the long-run trend in regional inequalities in current income per capita seems to accurately reflect the trend in such inequalities in real income per capita.[2] Although undelfated income will be used in this study the reader should keep in mind that this measure probably is an underestimate of the true level of regional inequality.

As noted above, in addition to analyzing regional differentials from a welfare point of view this study is concerned with the process of adjustment in regional economic activity. In this regard, it is important to exclude purely exogenous factors (such as taxes and transfers designed to reduce regional disparities) from any measures of inequality.

Various elements in personal income do not always reflect returns from economic activity within a region. A preferred measure of regional activity would exclude government transfer payments, interest, dividend and net rental income,and wage income accruing to persons in a region as a result of activity outside of the region. Such a procedure of excluding these components is, however, not without serious problems. Given the data there is no way of differentiating between income earned within and outside the region. While it would be safe to assume that very little wage and salary income would be earned outside of the region, the same cannot be assumed with regard to interest, dividend and rental income. One method of solving this problem is to exclude entirely from the measure of regional activity all components which may in a large part be earned in activities outside of the region. This procedure will be used here. As a proxy for regional economic activity or participation, "earned income per capita" will be used.[1] It is defined as wages, salaries, and supplemental income, plus net income received by farm operators from farm production, plus net income of non-farm unincorporated business. It excludes interest, dividend and rental income and certain income flows associated with corporate enterprise and government.

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[1] S.E. Chernick, Interregional Disparities in Income, p. 49.

[2] Ibid., p. 51.

2.2.2 INDEXES OF REGIONAL INEQUALITY

In measuring the interregional dispersion of any variable such as per capita income it is necessary to take account of the position of each and every region in relation to the national average. There are several available indexes which can do this. One such index is the Gini coefficient. This measure was first proposed as an index of income inequality by Morgan,[1] and is given by the proportion of the area under a 45° diagonal line which lies between the Lorenz curve and the diagonal line.

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[1] This income measure has been used in earlier studies by Chernick and Denton. See Chernick, ibid., p. 23 and Denton, _An Analysis of Interregional Differences in Manpower Utilization and Earnings_, p. 1.

A problem with using the Gini coefficient in this study is that it would be influenced by changes in the regional distribution of the population,[2] and therefore it would be difficult to make any intertemporal comparisons on the basis of this index. Since most of the focus of this study is on the causes of regional differences in the level of economic activity and changes therein over time

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[1] James Morgan, "The Anatomy of Income Distribution," Review of Economics and Statistics, 54, (August, 1962), pp. 270-283. See also, N.C. Kakwani and N. Poder, "On the Estimation of Lorenz Curves for Grouped Observations," International Economic Review, 14, (June, 1973), pp. 278-293.

[2] If for example, per capita income in region A remains 50% of that in region B over two periods but the population shifts from a 40-60 to a 20-80 distribution the Gini coefficient will fall. Consider the following hypothetical CASE:

	Period 1		Period 2	
	REGION A	REGION B	REGION A	REGION B
INCOME	200	600	105	840
POPULATION	40	60	20	80
PER CAPITA INCOME	5	10	5.25	10.5

In both cases per capita income in region A is 50% of that in region B, but while in period 1,40% of the population (region A) has 25% of the income and 60% of the population (region B) has 75% of the income, in period 2,20% of the population (region A) has 11.1% of the income and 80% of the population (region B) has 89.9% of the income. The Gini coefficient therefore falls.

regions are best viewed as having equal weight as observational units. That is, the weight given to each region in the calculation of the index of inequality should be independent of the relative size of each region's population. It should be noted however, that if the focus on regional inequality was strictly from a national and welfare viewpoint the Gini coefficient would be a satisfactory measure. For example if the relative per capita incomes in a set of regions remained constant over time, while at the same time there was a redistribution of the population away from the low income regions, it could be accurately concluded that national welfare had risen on the basis of a falling Gini coefficient.

A much less complicated index of regional inequality in terms of computation is the "relative mean deviation" index. This index which has been used by McInnis[1] is based on absolute deviations of the regional variables around the national average for the variable. It is defined as:

$$A_{uw} = \frac{\sum_{i=1}^{N} | y_i - \bar{y}|}{N} \Big/ \bar{y} \ ;$$

where y_i = income per capita in region i, $\bar{y}$ = income per capita in the nation, and N = number of regions.

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[1] McInnis, "The Trend of Regional Income Differences in Canada," pp. 442-443.

This unweighted index attaches equal weight to each region without regard to any possible regional differences in population size, density, geographic area or structure of economic activity, and thus avoids the problem associated with the Gini coefficient.

One of the more widely used measures of regional inequality is the "coefficient of variation." It measures the dispersion of regional variables relative to the national average and is defined (in the unweighted version) as the standard deviation of the distribution divided by the arithmetic mean. Symbolically:

$$V_{uw} = \sqrt{\frac{\sum_{i=1}^{N} (y_i - \bar{y})^2}{N-1}} \Big/ \bar{y} \; ;$$

where all variables are as previously defined.

This measure is a standardized version of the usual statistic for measuring the dispersion of a distribution. As such, there are several distinct advantages to using it as a measure of regional inequality. First, it is sensitive to changes in the distribution of regional variables since the values farthest from the mean are weighted most heavily. In this regard it should be noted that the choice between the "relative mean deviation" measure and the "coefficient of variation" measure does involve a judgement about the seriousness of varying degrees of variation around the national mean. If it is felt that an income differential which is twice as large as another is more than twice as serious the "coefficient of variation" is the appropriate measure.

A second advantage of using the "coefficient of variation" measure is that its value is independent of the absolute size of the units in which the variates are measured so that meaningful comparisons can be made over time and across countries.[1] Thirdly, this measure is quite amenable to a decomposition of variance type of analysis.[2] The latter can be used to determine the relative contributions to regional income inequality of variations in the various components of regional income.

Given these considerations the unweighted "coefficient of variation" (V_{uw}) best suits the purposes of this study. Thus it will be used as the measure of inequality. In some of the following sections the unweighted "relative mean deviation" (A_{uw}) will also be given for comparative purposes.

2.2.3 REGIONAL DELINEATION

A question of fundamental importance in any discussion of regional inequality concerns regional delineation. In the considerable literature dealing with this topic the general conclusion is that there is no unequivocal definition of a region.[1] Rather, it appears that the appropriate set of regions depends on the nature of the analysis and the type of problem being investigated. The criteria used in selecting regions in this study will be set out below.

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[1] It is important to note that if the standard deviation was not divided by the mean the measure of inequality would be sensitive to the absolute size of the units. Thus, for example, in the case of a constancy in the dispersion of relative regional incomes this index would show increasing regional inequality as absolute regional incomes diverged. Whether it is more appropriate to measure regional inequalities by absolute or relative income is a moot point as arguments for and against invariably come down to questions in welfare economics. This problem will not be dealt with here. Following tradition, inequality will be measured in terms of relative income differentials. An additional problem which arises is that changes over time and space in the absolute deviations of regional income are not easily interpreted. See E.J.R. Booth, "Interregional Income Differences," Southern Economic Journal, 31, (July, 1964), pp. 44-51.

[2] See Chernick, Interregional Disparities in Income, Appendix Note B.

Meyer[2] summarizes three traditional approaches to defining regions. The first stresses homogeneity with respect to some one or a combination of physical, social, economic or other characteristics. The second stresses nodality or polarization concepts and the third stresses political or administrative coherence. The homogeneity criteria simply requires that regions be chosen such that variations in some variable or variables be minimized intraregionally and maximized interregionally.[3] This approach has been used extensively by the Federal Government to designate regions requiring assistance and usually involves variables such as unemployment and income.

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[1] See J.R. Meyer, "Regional Economics: A Survey," American Economic Review, 53, (1963), pp. 19-54; M.B. Ullman and R.C. Klove, "The Geographic Area in Regional Economic Research," in Regional Income, Studies in Income and Wealth, 21, (Princeton: National Bureau of Economic Research, 1957); D.M. Ray, and B.J.L. Berry, "Multivariate Socio-Economic Regionalization: A Pilot Study in Central Canada," Regional Statistical Studies, (Toronto: University of Toronto Press, 1965); P. Camu, E.P. Weeks, and Z.W. Sametz, "The Development of a 68 Region System," Economic Geography of Canada, (Toronto: Macmillan of Canada, 1968), pp. 261-283.

[2] Meyer, ibid., pp. 20-25.

[3] Stated in this way, it can be seen that this approach is essentially one of stratified sampling where regions are the strata.

While the above three criteria for regional delineation are most commonly used they do not exhaust the list. Brewis,[1] for example, suggests regional delineation on the basis of growth potential. This approach relies heavily on "growth pole" theories of development and growth, and stresses large centres as the core of economic progress. Regions thus defined are particularly useful in relation to regional development policies.[2] Yet another method of delineating regions is embodied in a study by Camu, Weeks and Sametz.[3]

Whatever the ideal delineation of regions for a study of regional inequality there are several important considerations which effectively limit the range of choice. First, since one of the ultimate goals of research in the area of regional inequality must be to aid in the formulation of policies to reduce this inequality, the regional system used should have political and administrative coherence. Secondly, the regions must be chosen such that they conform to some set of regions used in statistical compilations if any empirical work it to be attempted. This immediately limits the choice to: (i) the 243 counties or Census Divisions, (ii) some combination of these 243 units, (iii) the 10 privinces, or (iv) some combination of the 10 provinces.

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[1] T.N. Brewis, Regional Economic Policies in Canada, (Toronto: Macmillan Company of Canada Ltd., 1969), pp. 48-50.

[2] See, for example John Friedmann, "The Concept of a Planning Region - The Evolution of an Idea in the United States," in John Friedmann and William Alonso, eds., Regional Development and Planning: A Reader, (Cambridge, Mass.: M.I.T. Press, 1964), pp. 497-518.

[3] P. Camu et.al., Economic Geography of Canada.

Two of the main advantages of using a set of regions based on (i) or (ii) are that counties and census divisions are relatively homogenous and they do not straddle political jurisdictions. A third possible advantage is that such an approach would produce a set of regions sufficiently numerous for regression analysis. Set against these advantages are three important disadvantages. First, the regions based on (i) are generally not nodal units and hence any regional system based on such units would lack functional integrity. Functional integrity means that each region is tied together in the sense that, for example, the population centre of each region provides the demand for agricultural output and supplies employment opportunities as well as processed goods and services to the rural area. Secondly, being relatively small and not being nodal units they are more likely to have serious "edge" effects than the provinces of which they are a part. In the study of regional disparities "edge effect" would be introduced when people live in one region and work in another. The greater the extent of this "fuzziness" between regions the less useful is such a set of regions for regional analysis. Finally, and most importantly, most of the types of data which are required in this study are not available on an annual basis for counties or census divisions.

Camu, Weeks and Sametz[1] have suggested a 68 region system where each region is basically the nodal type consisting of one or more counties or census divisions and therefore consistent with census data. While their system minimizes the problems of "edge effect" it runs against the problem of data limitations mentioned above.

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[1] P. Camu et. al., Economic Geography in Canada.

A third possible regional breakdown from a data availability viewpoint is the 10 provinces. Not only would such a breakdown produce a set of regions with a large degree of functional integrity but also, due to the size of the provinces, the "edge effect" would be minimized. A 10 province regional system would thus appear to satisfy most of the basic criteria for an economically useful definition of a region.

Unfortunately, however, even at this level of aggregation some of the statistics for variables employed in this study are not available on a provincial basis. In some cases where the statistics are based on samples[1] and where the samples are small (as is the case in provinces like Prince Edward Island, Newfoundland and Saskatchewan where the populations are relatively small) the degree of sampling variability exceeds the disclosure limits of Statistics Canada. In such cases a 5 region system is commonly used, consisting of:

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[1] For example, unemployment statistics.

(1) Atlantic Region (includes Newfoundland, Prince Edward Island, Nova Scotia and New Brunswick),

(2) Quebec,

(3) Ontario,

(4) Prairie Region (includes Manitoba, Saskatchewan and Alberta),

(5) British Columbia.

It would be expected that this 5 region system would exhibit an even more pronounced degree of functional integrity and a lesser degree of "edge effect" than a 10 region system, largely because each region is divorced from its neighbor(s) by some cultural or physical barrier. Furthermore, this 5 region system appears to fulfill the homogeneity criterion. Using Census income data, S. Shedd[1] calculated the unweighted dispersion of per capita income across subregions and regions in order to compare the degree of homogeneity within regions to that across regions. His results are given in Table 2.2.1.

In only one case (Quebec) was the subregional dispersion index higher than the interregional dispersion index (0.294 versus 0.219). It would thus appear that this 5 region breakdown would be satisfactory for studying regional inequality.

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[1] S. Shedd, Factors in Interregional Income Differences in Canada, Unpublished Ph.D. dissertation, (Southern Illinois University, 1971).

On the basis of the above arguments a 10 province regional breakdown is employed for the most part in this study. Only in those cases where provincial data are unavailable is the 5 region system used.

TABLE 2.2.1

SUBREGIONAL INCOME DISPERSION

REGION	COEFFICIENT OF VARIATION (V_{uw})%
Atlantic	.141
Quebec	.294
Ontario	.151
Prairies	.183
British Columbia	.134
Canada	.219

Source: S. Shedd, Factors in Interregional Income Differences in Canada, Unpublished Ph.D. dissertation, (Southern Illinois University, 1971), p. 32.

2.3 LONG-RUN TRENDS IN REGIONAL INCOME INEQUALITY

2.3.1 A SUMMARY OF EXISTING RESEARCH ON TRENDS IN CANADIAN REGIONAL INEQUALITY

Perhaps the most exhaustive study of regional income disparities is a Staff Study of the Economic Council of Canada by S.E. Chernick.[1] This study, which is mainly descriptive in nature, outlines the nature and severity of the problem and discusses trends in regional income dispersion for the period 1926-64. The study is based on the National Accounts Statement of Provincial Incomes and employs both a ten province and a five region breakdown.

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[1] S.E. Chernick, Interregional Disparities in Income.

With respect to the trend of regional inequality in personal income per capita over the period 1926-64 as measured by the unweighted coefficient of variation, Chernick concludes that:

> . . . over a period of Canadian economic history spanning almost forty years, the interregional structure of income has hardly changed; and the degree of regional participation in national economic activity that obtained in the mid-sixties is much the same as it was in the mid-twenties.[1]

There were however, many short-run fluctuations in regional inequality as evidenced by Chernick's study. The index rose sharply just after 1928, reached a maximum during the early 1930's, and then fell to a minimum during 1945.[2] Following this there was another sharp increase up to 1950 and then a downward trend. From this it is evident that any conclusions about long-run trends in regional inequality will depend critically on the period of history used as evidence.

Using earned income per capita as a measure of regional activity Chernick found basically the same time pattern as when personal income per capita was used, although earned income per capita generally produced a higher index than did personal income per capita.

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[1] Ibid., pp. 11-12.

[2] This latter fall is largely related to the equalizing effect, particularly on the Maritimes, of the war effort and the recovery of the Prairies from the drought and low wheat prices of the 1930's.

That is,

> To the extent that earned income per capita reflects the volume of economic activity and income generated within the geographic boundary of the province, the degree of provincial participation in national economic activity is more divergent.[1]

On the basis of earned income per worker (a proxy for regional productivity) the index of regional inequality was found to follow the same basic trend as that based on personal income per capita and to be somewhat less than either the index based on personal income per capita or earned income per capita. The latter would in turn indicate significant regional differences in manpower availability and utilization.

Several other aspects of Chernick's research are relevant to this study. First, on the basis of regional price indexes based on major regional city surveys he calculated the coefficient of variation for real personal income per capita. As indicated earlier, this series is slightly higher than that for current personal income per capita but the long run trends in these series do not appear to be different.[2]

A second important result is that on the basis of an unweighted coefficient of variation for the various components of personal income per capita it was found that government transfer payments and non-farm unincorporated business income have generally been in the direction of decreasing regional inequality. At the same time, it was evident that farm income and property income tend to be distributed in a way which increases regional inequality. The trend of the dispersion of labor income over time has been about the same as that for personal income per capita and thus appears to have exerted a neutral influence on regional inequality.

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[1] Ibid., p. 25.

[2] Ibid., p. 51.

A second piece of research related to this study is that by Marvin McInnis.[1] His work on regional income differentials in Canada, like Chernick's, is largely descriptive. Using national income data for the period 1926-62, he also finds that the interregional dispersion of per capita income has remained relatively constant for the period taken as a whole, and that over this term there has been little change in the relative positions of the individual regions. In addition, he suggests that whatever slight convergence there may have been was a result of a redistribution of income through government transfer payments. Thus, as far as endogenous regional economic adjustment is concerned this buttresses his conclusions about the long-term constancy of regional inequality.[2]

The substantive contribution of McInnis's work however, is his work on the question of the extent to which:

> . . . this constancy [is] a product of some peculiarity of the initial years of the series, 1926 and 1927, arbitrarily chosen because they are the first years for which the statistics are available?[3]

In his attempt to deal with this question, the author used census data to construct estimates of regional per capita income[4] for two census years prior to 1926. On the basis of these estimates he found that a long-term constancy in the interregional structure of income extends back to at least the census year 1920-21 and is not limited to the period 1926-62. At the same time, he found that the level of inequality in 1910-11 was significantly greater than that in 1920-21. This was largely due to the extremely high relative position of British Columbia in the early years. Between the years 1910-11 and 1920-21 participation income per capita in British Columbia relative to that for Canada fell from about 186% to 121%.[1]

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[1] Marvin McInnis, "The Trend of Regional Income Differentials in Canada."

[2] Ibid., p. 445.

[3] Ibid., p. 445.

[4] The income measure used is "participation" income which is defined as wages and salaries plus the income of independent business. This particular measure was dictated by data availability.

In a third study of Canadian regional inequality Alan Green,[2] on the basis of estimates of gross value added per capita for the period 1890-1956, concluded that the level of regional inequality was about the same in 1956 as it was in 1890. He found, however, that there were changes in the level of inequality over the intervening period. In fact, the most interesting aspects of Green's research are his attempts to relate these changes in regional inequality to Canadian economic growth and the redistribution associated with the settlement of new regions. On the basis of an analysis of regional inequality over the period 1890-1929 he concluded that,

> Rapid countrywide economic growth between 1890-1910 . . . was accompanied by a growing disparity among the provinces in average and per worker terms whereas the slower national growth during the second period [1910-1929] showed less

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[1] See Table IV, ibid., p. 447.

[2] Alan G. Green, Regional Aspects of Canada's Economic Growth, (Toronto: University of Toronto Press, 1971).

change in these newly established levels.[1]

Williamson[2] also made an attempt to extend the estimates of regional inequality back in time in order to determine the long-run trend. Comparing indexes of regional inequality based on the share of agriculture in the regional labor force (as a proxy for income per capita) for six census years beginning in 1901 Williamson found that the level of inequality rises from 1901 to a peak level in 1931 and then declines to 1951. Also, the index in 1961 (as calculated by Chernick[3]) is about the same as that for 1901. While the proxy for income per capita is quite imperfect and does not take account of the possible effects on regional inequality of differences in levels of activity in the nation when making comparisons, his results are nevertheless suggestive.

The bulk of Williamson's research is devoted to describing the relationship between the level of regional inequality and national development. In general he finds that there is a pattern of increasing inequality during the early development stages and decreasing inequality during the more mature stages of national growth and development. This pattern is supported by an international cross-section of twenty-four nations and by various time-series analyses. An interesting result, however, is that Canada is somewhat of an exception to this generalized pattern.

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[1] Alan G. Green, "Regional Aspects of Canada's Economic Growth, 1890-1929," Canadian Journal of Economics and Political Science, 33, (May, 1967), p. 242.

[2] Williamson, "Regional Inequality and the Process of National Development: A Description of the Patterns," p. 33.

[3] Chernick, Interregional Disparities in Income, p. 12.

A criticism which can be levelled against the above research is that while there is considerable evidence of a relationship between variations in the degree of regional income inequality and variations in the overall level of activity in the national economy, little attempt has been made to take this relationship into account in determining long-run trends. Clearly if it is at all significant, accurate estimates of long-run trends can only be determined on the basis of a sample in which the end-points represent similar overall levels of economic activity. As will be seen in later sections, conclusions about the long-run trend of Canadian regional inequality depend critically on the end-points chosen for the analysis.

Further to this, little attention has been paid to the effects which exceptional occurrences such as World War II and the depression of the 1930's had on regional inequality. It is quite evident, for example, that while the Canadian war effort involved favorable exogenous effects on the Maritime economy, the drought and depression had very pronounced and unfavorable effects on the Prairie economy. It is unlikely that an unbiased measure of any change in regional inequality associated with normal regional adjustment can be obtained unless such factors are taken into account.

A shortcoming of most of the studies summarized above is that they have not provided any type of systematic analysis of the trends for the individual regions. The summary measures of regional inequality which are typically employed do not provide any information as to whether the trend in regional inequality is due to constant relative positions or offsetting changes in the relative positions of each of the individual regions. This latter type of information is particularly important from the point of view of determining whether or not the observed trends can be interpreted as some type of long-run equilibrium. All of these points will be taken into consideration in the analysis of trends presented below.

2.3.2 AN ANALYSIS OF THE TREND OF REGIONAL INEQUALITY IN PER CAPITA INCOME, 1926-1971

The main purpose of this section is to determine whether more recent experience alters the conclusions of earlier research on the trends of regional inequality cited above,[1] and to determine the long-run trends in the relative per capita income positions of individual regions. The latter is necessary in order to assess the validity of any long-run equilibrium interpretation of Canadian regional inequality.

Using the provincial personal income per capita series from the National Accounts Income and Expenditure,[2] the "coefficient of variation" index (V_{uw}) and the "relative mean deviation" index (A_{uw}) were computed for the period 1926-1971. These are set out in Table 1 in Appendix I. One series of inequality measures is calculated with

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[1] It will be recalled that the most recent analysis (by Chernick, Interregional Disparities in Income) is based on data up to 1964.

[2] Statistics Canada, National Accounts Income and Expenditure, 1971 (Ottawa: Queen's Printer, 1971).

Newfoundland excluded in order to isolate the effect which the addition of this province to the nation in 1949 may have had on the long-run trend.

Time trends were fitted using Ordinary Least Squares (OLS) to determine the long-run trends of these series over the period 1926-1971. These estimated trend lines are summarized in Table 2.3.1. It can be seen that there is a statistically significant[1] long-run decrease in the level of regional inequality over this period. However the process is very slow. According to the estimates, V_{uw} and A_{uw} fell by only one-fifth of one percentage point per year. In comparison to the decrease in regional inequality experienced by most of the countries in Williamson's sample[2] over a shorter period of time this decrease is slight. For example, over the thirty year period 1930-1960, the decrease in regional inequality in Sweden and the United States was roughly five and three times respectively that which would have occurred in Canada over the same length of time with the rate of convergence estimated above. The actual differences in rates of convergence were in fact much greater.

In addition, an examination of Table 1 (Appendix I) reveals that the process is quite irregular. That is, there are large short-run increases and decreases in the degree of regional inequality over this period. In the light of these results it would appear that for the

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[1] The critical t value for 44 degrees of freedom and a two-tailed test at the 1 per cent level is 2.7.

[2] See Williamson, "Regional Inequality and the Process of National Development: A Description of Patterns," Table 5.

1926-1971 period at least, any levelling of regional disparities in Canada has been slight and relatively unimportant, particularly in comparison to that experienced by other developed countries.

TABLE 2.3.1

OLS REGRESSIONS OF INDEXES OF DISPERSION, A_{uw} and V_{uw}, ON TIME (T), 1926-71. (t-RATIOS IN PARENTHESES)

REGRESSION 1:	$A_{uw} = C + \alpha T$	
OLS ESTIMATE:	$A_{uw} = 25.6 - .2T$ (35.6) (-7.5)	$R^2 = .56$
REGRESSION 2:	$V_{uw} = C + \alpha T$	
OLS ESTIMATE:	$V_{uw} = 29.3 - .2T$ (42.7) (-7.8)	$R^2 = .58$

The coefficient of variation does not give any information as to the long-run stability of the relative regional levels of per capita income. In order to determine whether the long-run pattern of regional inequality is perhaps the result of a peculiar interaction of continually shifting relative positions of the provinces relative regional personal per capita income was calculated for each of the provinces for the period 1926-71. These figures are given in Tables 2 and 3 in Appendix I.[1]

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[1] Ideally provincial comparisons should be based on income per capita in province i as a percentage of a national average which excludes that province. In the case of Ontario and Quebec, due to their large relative size (with respect to income and population), this method would give much higher relative positions than indicated in Table 2, but the long-run trend would be unaffected. For example, excluding Ontario in the calculation of the national average, Ontario's relative position in 1949 and 1971 is 131% and 128% respectively versus 119% and 116% respectively if it is not excluded in the calculation. Such differences are minor for the smaller provinces.

To determine the long-run trends for each of the provinces provincial income per capita as a percentage of national personal income per capita was regressed (using OLS) on time. These results are presented in Table 2.3.2.

Perhaps the most outstanding trend over the period 1926 to 1971 is the significant and fairly regular decline in British Columbia's relative position. The estimated coefficient on time suggests that personal income per capita as a percentage of that for Canada fell by about one-half of one percentage point per annum over this period.

A second unmistakable trend is the long-run constancy in the relative positions of Quebec and Nova Scotia. This is indicated in the Table by the small and insignificant coefficients for the time variable in these cases. The trends for the relative positions of the remaining provinces are much more difficult to interpret. For example, although the results for Saskatchewan indicate a significant convergence (at the 5 per cent level) over the period this is due mostly to its unusually poor relative position during the 1930's. In fact, the plots of the regressions for the predominantly agriculture based provinces[1] suggest that this was the major reason for the indicated statistically

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[1] The depression and drought of the 1930's had its greatest impact on the agricultural sector. Due to its almost total specialization in agriculture Saskatchewan was by far the hardest hit at that time. The relative personal income per capita position of Saskatchewan fell from over 100% in 1928 to about 44% in 1931. The national average was not again achieved until 1948. The provinces of Alberta and Manitoba followed Saskatchewan in terms of the severity of the impact of the depression.

TABLE 2.3.2

RESULTS OF REGRESSIONS OF RELATIVE PERSONAL PER CAPITA INCOME ($y_i/\bar{y}$) ON TIME (T) FOR NINE PROVINCES (EXCLUDES NEWFOUNDLAND), 1926-71

OLS ESTIMATES FOR THE EQUATION:
$y_i/\bar{y} = C + \alpha T$ (t ratio in parenthesis)

Prov.	C	α	R^2	Mean Relative Per Capita Income (%)	Long Run Prov. Ranking
P.E.I.	51.3 (44.7)*	.18 (4.3)*	.30	55.6	9
N.S.	74.9 (67.6)*	.02 (.4)	.00	75.3	7
N.B.	64.0 (83.6)*	.11 (3.9)*	.25	66.5	8
Que.	88.1 (84.8)*	-.04 (-.93)	.02	87.2	5
Ont.	124.3 (116.4)*	-.20 (-5.0)*	.37	119.6	1
Man.	97.3 (73.6)*	-.06 (-1.3)	.04	95.8	4
Sask.	70.7 (14.2)*	.42 (2.3)	.10	80.6	6
Alta.	92.0 (29.9)*	.20 (1.8)	.07	96.7	3
B.C.	129.8 (111.0)*	-.45 (-10.4)*	.71	119.2	2

*Indicates significance at the 1% level. (For two-tailed test.)

significant convergence. In order to remove this bias to the long-run trend this period is eliminated from the sample in the following section.

With respect to the cases of Prince Edward Island and New Brunswick it should be noted that the indicated slight convergence is due almost entirely to improvements in their relative positions after 1960. Prior to this period a constant trend is apparent. In any case the rate of convergence is extremely small -- between one-tenth and one-fifth of a percentage point per year.

To sum up, it appears that the relatively small long-run decrease in regional inequality in Canada has been largely due to a steady decline in British Columbia's above average relative position. The remaining provinces (excluding Newfoundland), while exhibiting much greater short-run variations in their relative positions, do not show any substantial gains or losses over the period 1926-71.

2.3.3 A MODIFIED ANALYSIS OF THE TREND OF REGIONAL INEQUALITY IN PER CAPITA INCOME, 1926-1971

The preceding analysis was based on the complete period 1926-1971. This period includes a major depression and a major war and it is possible that the inclusion these events may lead to a bias in the trend of regional income inequality. Among the major disruptions during the depression was a sharp drop in the relative positions of the provinces whose economies were based on agriculture. The war, on the other hand, brought a number of equalizing factors. These included the policy of decentralization of war production and military establishments, the uniformity in pay scales of the armed forces, the introduction of family allowances, and the increased activity in the Atlantic seaports which provided considerable stimulus to incomes in the lower income per capita provinces.[1] In addition, the war period saw the recovery of the Prairie economies.

In order to remove any possible biases resulting from these events the complete cycles associated with the depression and the years in which the bulk of the war effort expenditures were made were removed from the 1926 to 1971 income series. On the basis of Chamber's "reference" cycles[2] the years 1929 to 1937 inclusive were eliminated in order to remove the depression cycle and the years 1942 to 1945 inclusive were deleted in order to remove any possible war effects.

On the basis of the remaining 33 observations the two unweighted measures of regional inequality, A_{uw} and V_{uw}, were regressed on time. The results are presented in Table 2.3.3.

It is evident that while there is a statistically significant levelling of regional income inequality, the long-run rate of change is extremely small - slightly more than one-tenth of one percentage point per year. Furthermore, in comparing these results with those for the complete period 1926-1971 (see Table 2.3.2) the rate of decline in regional inequality is even less when the war and depression periods are excluded. It should also be noted that this decrease in inequality, slight as it is, is almost entirely due to a fall in the relative income position of British Columbia.

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[1] This effect can be seen in the relative income figures for Prince Edward Island, Nova Scotia and New Brunswick given in Table 2, (Appendix I).

[2] See Edward J. Chambers, "Canadian Business Cycles and Merchandise Exports," Canadian Journal of Economics and Political Science, (August, 1958), pp. 406-410.

TABLE 2.3.3

OLS REGRESSIONS OF INDEXES OF DISPERSION, A_{uw} AND V_{uw}, ON TIME (T), 1926-28, 1938-41 and 1946-71. (t-RATIOS IN PARENTHESES)

REGRESSION 1:	$A_{uw} = C + \alpha T$	
OLS ESTIMATE:	$A_{uw} = 23.1 - .13T$	$R^2 = .41$
	(26.6) (-4.6)	
REGRESSION 2:	$V_{uw} = C + \alpha T$	
OLS ESTIMATE:	$V_{uw} = 27.0 - .13T$	$R^2 = .45$
	(32.8) (-5.0)	

2.3.4 AN ANALYSIS OF THE TREND OF REGIONAL INEQUALITY IN PER CAPITA INCOME FOR THE PERIOD 1949-1971

This section investigates the trend of regional inequality in the post-war period. The attempt to establish the trend for this period is made for two reasons. First, it is possible that the impact of the war expenditures continued well beyond the years in which the bulk of them were made. That is, it may take some time after an initial shock for the long-run equilibrium (if such exists) to be restored. If this is the case then even the preceding analysis would produce a biased trend. An analysis based on the period beyond (say) the late forties or early fifties should not suffer in this respect. A second reason for choosing this period is that the research in later chapters, which relies on the results of this chapter, is limited by data availability to this period.

Since the goal here, as before, is to establish long-run rather than cyclical trends care must be taken in choosing the end-points of the sample. Clearly, if the level of regional inequality is systematically related to the overall level of economic activity then choosing end-points which correspond to different phases of the cycle would lead to a bias in the trend line. There is some evidence that the level of regional inequality varies systematically over the business cycle. Chernick concludes that:

> . . . while the national unemployment level does not tell the whole story, periods of high economic activity in the post-war period have been accompanied by a wider spread in the interregional structure of labor income per capita.[1]

Hanna[2] has found a similar inverse relationship between the coefficient of variation and changes in the level of national income in the United States. Green[3] found a similar relationship, at least for the period 1890-1929, in Canada. Given this evidence it is crucial to determine the phases of the post-war business cycles so that the proper end years can be chosen. The immediate problem posed, however, is that of determining which cycle is relevant; the cycle as determined by the national unemployment rate or that determined by changes in national income.[4]

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[1] Chernick, Interregional Disparities in Income, p. 11.

[2] Hanna, State Income Differentials, 1919-1954, p. 35.

[3] Green, "Regional Aspects of Canada's Economic Growth, 1890-1929," p. 242.

[4] Chamber's reference cycles could not be used since they do not include more recent years.

The problem arises in that these two cycles are not always in phase. For example, the unemployment rate had reached its peak in 1971 while the change in the Gross National Product reached its low point in the previous year.

Since Chernick suggests a relationship between inequality and the unemployment rate the relative national unemployment rate[1] was used to isolate the cycles over the post-war period. This criterion suggests that 1949 would be a choice consistent with 1971, the last year for which provincial data are available.[2]

On the basis of a sample period of 1949 to 1971 inclusive A_{uw} and V_{uw} were regressed on time. The results are given in Table 2.3.4. There it can be seen that the post-war trend in regional inequality (when Newfoundland is excluded) is approximately the same as that for the much longer period 1926-1971. In both cases, while there is a statistically significant decline in the level of regional income inequality it is slight and relatively unimportant, at least in comparison to that observed in other developed countries. It is interesting to note however, that when Newfoundland is included in the sample the trend becomes more regular and the rate of overall convergence is increased. As will be seen below this is due to the steady increase in the relative personal income per capita position of that province since joining Confederation.

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[1] That is, the end years are chosen such that they both saw a high or low unemployment rate relative to that for the intermediate years. It is impossible to choose years with approximately the same absolute unemployment rate due to the significant upward trend in (structural) unemployment over this period.

[2] In both 1949 and 1971, national unemployment was at a cyclical peak.

TABLE 2.3.4

OLS REGRESSIONS OF INDEXES OF DISPERSION, A_{uw} and V_{uw}, ON TIME (T), 1949-71, (t-RATIOS IN PARENTHESES)

REGRESSION 1, (excludes Nfld.):	$A_{uw} = C + \alpha T$	
OLS ESTIMATE:	$A_{uw} = 24.5 - .17T$	$R^2 = .52$
	(19.5) (-4.8)	
REGRESSION 2, (excludes Nfld.):	$V_{uw} = C + \alpha T$	
OLS ESTIMATE:	$V_{uw} = 30.3 - .22T$	$R^2 = .67$
	(24.9) (-6.5)	
REGRESSION 3, (includes Nfld.):	$A_{uw} = C + \alpha T$	
OLS ESTIMATE:	$A_{uw} = 29.4 - .24T$	$R^2 = .76$
	(27.7) (-8.2)	
REGRESSION 4, (includes Nfld.):	$V_{uw} = C + \alpha T$	
OLS ESTIMATE:	$V_{uw} = 35.9 - .30T$	$R^2 = .87$
	(39.2) (-11.8)	

As noted earlier the trends for some of the individual provinces were biased due to the inclusion of the war and the depression years in the sample. In order to remove these irregularities, trends were fitted for each of the provinces for the post-war period. The results are presented in Table 2.3.5. By far the most pronounced trends evident there are those for British Columbia and Newfoundland.

TABLE 2.3.5

RESULTS OF REGRESSIONS OF RELATIVE PERSONAL PER CAPITA INCOME ($y_i/\bar{y}$) ON TIME (T) FOR TEN PROVINCES, 1949-71

OLS ESTIMATES BY PROV. FOR THE EQUATION:
$y_i/\bar{y} = C + \alpha T$ (t ratios in brackets)

Prov.	C	α	R^2	Mean Relative Per Capita Income (%)	Long-Run Ranking
Nfld.	32.4 (20.8)*	.67 (15.3)*	.92	55.9	10
P.E.I.	38.4 (11.1)*	.54 (5.6)*	.60	57.4	9
N.S.	66.2 (37.9)*	.23 (4.7)*	.51	74.3	7
N.B.	59.4 (28.8)*	.22 (3.9)*	.42	67.3	8
Que.	78.7 (59.0)*	.24 (6.3)*	.65	87.0	5
Ont.	120.3 (105.1)*	-.11 (-3.1)*	.31	116.9	1
Man.	104.5 (39.8)*	-.26 (-3.5)*	.37	95.4	4
Sask.	110.3 (10.3)*	-.67 (-2.2)	.19	86.9	6
Alta.	110.7 (34.5)*	-.30 (-3.3)*	.34	100.3	3
B.C.	136.7 (58.0)*	-.63 (-9.6)*	.81	114.6	2

*Indicates significance at the 1% level. (For a two-tailed test.)

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Both of these provinces regressed toward the national average over the post-war period at about 0.6 of a percentage point per year. Further, the relatively high coefficients of determination reflect the steadiness of this trend.

As indicated in a preceding section the trends of the Prairie Provinces are difficult to determine due to the effects of the abrupt swings in agricultural markets. Ideally, in assessing the trends in such cases the period should include about the same number of "booms" and "busts" in such markets. The plots of the regressions for Alberta, Saskatchewan and Manitoba indicate that the divergent trends for these provinces are largely a result of the extremely buoyant agricultural markets in the early 1950's. If, as expected, the data for 1973-74 indicates the recurrence of such conditions this trend will be completely altered and for Alberta and Saskatchewan at least, will provide support for a conclusion of a long-run constancy. There is some evidence that Manitoba's relative income position has deteriorated slightly over this period.

The cases of Nova Scotia and New Brunswick are also somewhat difficult to interpret. Although the results in Table 2.3.5 indicate statistically significant but slight convergence at a rate of about one-fifth of one percentage point per year, this result depends critically on the time period used. If the period 1946-1971 is used rather than 1949 to 1971 there is no significant trend. It would appear that due to the spillover effects of the war effort both of these provinces were favorably affected until early 1950. These effects tend to cancel the trend beyond this period. In any case, it would probably be safe to conclude that any levelling in the relative positions of Nova Scotia and New Brunswick has been very slight. Prince Edward Island, by comparison, has shown a fairly steady improvement in its relative position at a rate of about one-half of one percentage point per year.

Although the results for Quebec show a statistically significant convergence over this period the rate is small (about one-fifth of one percentage point per year). In addition, the trend appears to be non-linear. The plots for the regression show a slight levelling over the 1950's and then a relative constancy over the 1960's. Ontario, on the other hand, has tended to regress toward the national average at a rate of about one-tenth of one percentage point per year.

In general then, the slight decrease in the interregional dispersion of personal income that occurred in the post-war period was largely due to a convergence in the relative positions of British Columbia and Newfoundland and to a lesser extent due to a convergence in Prince Edward Island's position. The remaining six provinces have experienced little if any change in their relative income per capita positions; when account is taken of the sensitivity of the long-run trend to the end-points of the sample period there is no convincing evidence of either convergence or divergence.

2.3.5 AN ANALYSIS OF THE TREND OF REGIONAL INEQUALITY IN EARNED INCOME PER CAPITA FOR THE PERIOD 1949-1971

As noted earlier personal income per capita may not be the best figure upon which to calculate an index of disparities in regional participation. Not only does personal income include government transfers which are exogenous from the view of regional adjustment but it contains some elements which do not reflect returns to activity within the region. Earned income per capita as defined above[1] excludes both government transfers to persons and those components of regional income which depend on activity outside of the region and thus may be a better basis for a measure of endogenous regional adjustment.

Indexes of dispersion for earned income per capita for the 1949-1971 period and the results of a regression of these indexes on time for this same period are given in Table 4 (Appendix I) and Table 2.3.6 respectively. Several interesting trends are evident in these results. First, comparing the figures in Table 4 (Appendix I) with those in Table 1 (Appendix I) indicates that the degree of regional inequality as measured by differences in earned income per capita is slightly more severe than that as measured by differences in personal income per capita. Second, comparing the results in Table 2.3.6 with those in Table 2.3.4 indicates that while both indexes show a statistically significant decline over this period, compared to the decline of the indexes based on personal income per capita the decline in regional inequality in earned income per capita is less. The coefficient for time indicates that the coefficient for time based on earned income per capita falls at about 0.17 of a percentage point per year while that for personal income per capita falls at about 0.3 of a percentage point per year. (See Table 2.3.4.) In addition, inequality based on earned income per capita shows greater short-run variation than that based on personal income per capita.

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[1] See page 21.

TABLE 2.3.6

OLS REGRESSION OF INDEXES OF REGIONAL DISPERSION OF EARNED INCOME PER CAPITA, A_{uw} AND V_{uw}, ON TIME (T), 1949-1971

(t-RATIOS IN PARENTHESES)

REGRESSION 1, (includes Nfld.):	$A_{uw} = C + \alpha T$	
OLS ESTIMATE:	$A_{uw} = 25.2 - .23T$ (57.4) (-4.9)	$R^2 = .54$
REGRESSION 2, (includes Nfld.):	$V_{uw} = C + \alpha T$	
OLS ESTIMATE:	$V_{uw} = 30.5 - .17T$ (76.8) (-5.8)	$R^2 = .61$

In general then, it appears that from a regional participation viewpoint regional inequality has shown a small decrease over the post-war period. Further, this decrease is even less than that in terms of personal income per capita.[1] This would tend to reinforce the conclusions of previous research that there has been little change in the degree of inequality in regional activity in Canada over the post-war period.

The relative earned income per capita positions for each of the provinces for the post-war period are given in Table 5 (Appendix I). The results of the regressions of these regional relatives on a time variable are presented in Table 2.3.7. These indicate that the provincial

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[1] See Chernick, Interregional Disparities in Income, p. 23. Prior to W.W. II the trend based on earned income per capita is very similar to that based on personal income per capita.

TABLE 2.3.7

RESULTS OF REGRESSIONS OF RELATIVE EARNED INCOME PER CAPITA ($y_{ei}/\bar{y}_e$) ON TIME (T) FOR TEN PROVINCES, 1949-1971

OLS ESTIMATES BY PROV. FOR THE EQUATION:
$y_{ei}/\bar{y}_e = C + \alpha T$ (t ratios in brackets)

Prov.	C	α	R^2	Mean Relative Per Capita Income (%)	Long-Run Ranking
Nfld.	47.6 (69.8)*	.46 (9.2)*	.80	53.1	9
P.E.I.	48.5 (33.6)*	.23 (2.1)	.18	51.2	10
N.S.	67.3 (75.7)*	.03 (.4)	.01	67.6	7
N.B.	62.0 (56.6)*	.11 (1.4)	.08	63.3	8
Que.	85.1 (138.0)*	.26 (5.7)*	.61	88.0	6
Ont.	121.1 (193.0)*	-.09 (-1.97)	.17	120.0	1
Man.	101.0 (89.0)*	-.40 (-4.9)*	.53	96.2	4
Sask.	99.9 (19.9)*	-.93 (-2.6)	.24	88.7	5
Alta.	107.1 (72.1)*	-.40 (-3.7)*	.40	102.2	3
B.C.	121.0 (119.7)*	-.58 (-7.9)*	.75	114	2

*Indicates significance at the 1% level (for two-tailed tests).

trends are basically the same as those based on personal income per capita, although somewhat less pronounced. The clearest trends are, as before, the steady and significant decrease and increase in the respective relative positions of British Columbia and Newfoundland. While there is a statistically significant convergent trend for both Prince Edward Island and Quebec, the rate of improvement in their relative positions is extremely small. Although some trends of a divergent nature are evident for the Prairie Provinces the same cautious interpretation of these trends as was given earlier should be applied here as well.[1]

The largest differences between the provincial relatives for earned income and personal income show up for the provinces of Ontario, Nova Scotia and New Brunswick. Whereas previously there was evidence of some levelling in their relative positions (albeit slight), in terms of earned income per capita there is not even evidence of a statistically significant convergent trend. Thus, over the post-war period, these provinces' shares of economic activity have remained virtually constant.

2.4 TRENDS OF FACTORS ASSOCIATED WITH CANADIAN REGIONAL INCOME INEQUALITY

2.4.1 EXISTING RESEARCH ON FACTORS ASSOCIATED WITH CANADIAN REGIONAL INCOME INEQUALITY

In any attempt to explain the long-run trends in Canadian regional inequality it would be desirable to have an explanation for the degree of regional inequality at some given point in time. Unfortunately, there have been few systematic studies of the determinants of Canadian regional income inequality. Furthermore, for the most part the studies that have been done have concentrated on statistical rather than economic explanations of such inequality. More will be said about this below. The most important studies in this area of regional inequality include those by Chernick,[1] Denton,[2] and Poduluk.[3] Other more specialized studies have been done by George[4] and by Caves and Holton.[5]

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[1] As already noted these trends are primarily a result of unusually favorable economic conditions in the agricultural sector during the early 1950's.

The results of Chernick's research which are relevant to this study have already been mentioned in preceding sections. One conclusion however, which is worth reiterating is that about three-fifths and two-fifths of the inequality in earned income per capita[6] are due to inequality in earnings per worker and inequality in employment bases[1] respectively. Given this, it is clear that the most important element of any explanation of regional income inequality will be an explanation of regional wage inequality. It should be noted that the inequality in employment bases is related to the regional structure of participation rates, unemployment rates and the age distributions of the regional populations.[2]

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[1] Chernick, Interregional Disparities in Income.

[2] Denton, An Analysis of Interregional Differences in Manpower Utilization and Earnings.

[3] Jenny Poduluk, Incomes of Canadians, D.B.S. monograph, (Ottawa: Queen's Printer, 1968).

[4] R.E. George, A Leader and a Laggard, (Toronto: University of Toronto, 1970).

[5] Richard E. Caves and Richard H. Holton, The Canadian Economy: Prospect and Retrospect, (Cambridge, Mass.: Harvard University Press, 1959).

[6] Recall that the bulk of the regional variations in income per capita is due to regional variations in earned income per capita.

The study by Poduluk employs 1961 Census data and examines the importance of four factors in regional differences in average incomes of make workers. These are: (i) the age structure of the labor force, (ii) the rural-urban distribution of the labor force, (iii) the level of education of the labor force, and (iv) the occupational structure of the labor force. One of the main conclusions of this study is that while regional differences in levels of schooling of the labor force and the rural-urban distribution of the labor force account for part of the

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[1] The regional employment base is defined as the percentage of the regional population which is employed.

[2] If Y_e = earned income, P = total population and L = total employment, then:

$$Y_e/P = \frac{Y_e}{L} \cdot \frac{L}{P}$$

Letting P_1 = source population (that is, non-institutionalized population 14 years of age and over), P_2 = residual population = $P - P_1$, p = the participation rate, U = total unemployment, and LF = the labor force, L/P can be written as:

$$L/P = \frac{LF-U}{P} = \frac{p.P_1-U}{P} = \frac{p.P_1}{P} - \frac{u^*}{1+P_2/P_1};$$

where u* = the unemployment rate. Thus it can be seen that earned income per capita is positively related to earnings per worker, the participation rate, and the percentage of the population classified as source population, and inversely related to the unemployment rate.

regional differences in average earnings of males, most of this inequality remains to be accounted for. It will be recalled that Denton who looked at earnings for all workers rather than just earnings for male workers, and considered several more factors than did Poduluk,[1] reached basically the same conclusion.

The studies of both Denton and Poduluk are statistical and symptom oriented rather than economic and causality oriented. Both use the "standardization" method of analysis[2] which involves the generation of various weighted averages. Although this method may be useful in terms of suggesting some of the factors associated with regional income differences, it is not useful in terms of explaining the basic causes.[3] For example, although regional differences in unemployment and participation rates are found to account for some of the differences in regional income per capita no explanation is offered as to why regional unemployment or participation rates vary. Clearly it is this latter type of explanation which is required in order to make policy recommendations.

Perhaps the most damaging criticism of the standardization procedure used in the above mentioned studies is that it assumes that the variables included in the analysis are independent when in fact this is rarely the case. Many of the variables, such as unemployment and participation rates,[1] are closely related and it is therefore impossible to get at the underlying cause of regional inequality unless such interrelationships are taken account of in the analysis.

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[1] See p. 4.

[2] See Frank Hanna, State Income Differentials, 1919-1954, (Durham, N.C.: Duke University Press, 1959), "Appendix B" for a discussion of the standardization technique.

[3] It should be noted that Denton was fully aware of this shortcoming of the standardization method of analysis.

While statistical explanations are less than ideal from the point of view of understanding the true causes of regional disparities, they do act as guideposts in isolating the most important factors in regional inequality. It is in this light that attention is focused on regional inequalities in earnings and employment bases in this study.

It will be recalled that the two factors in regional inequality in earned income per capita are inequalities in employment bases and inequalities in earnings per worker or wages. Further, as indicated, regional inequalities in these factors account for roughly two-fifths and three-fifths respectively of the inequality in earned income per capita. Given this, the long-run trends of regional inequality in each of these factors must be established in order to assess the plausibility of a long-run equilibrium interpretation of the trend in Canadian regional inequality. That is, it is necessary to determine whether the trend in inequality with respect to earned income per capita set out in the previous section is due to offsetting changes in inequalities with respect to employment bases and earnings per worker, or a relative long-run stability in each. If there is an increase in regional inequality in employment bases, but a general convergence of wages, any explanation of the lack of substantial changes in Canadian regional inequality must involve an explanation of the increasing inequality in employment bases. Only in the latter case could one suggest a long-run equilibrium of the type predicted by most economic theory.

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[1] See for example, N.M. Swan, Response of Labor Supply to Demand in Canadian Regions, Discussion Paper 116, (Queen's University, 1973). There the participation rate is related to, among other variables, the unemployment rate. Both the "discouraged worker" and "added worker" hypotheses for participation rates involve a relationship between unemployment and participation rates.

2.4.2 AN ANALYSIS OF THE TREND OF REGIONAL INEQUALITY IN EMPLOYMENT BASES, 1949-1971

Since annual data on employment are only available on a five region breakdown for this period the measures of regional inequality in the employment base must be limited to that basis. Regional values for the employment base[1] along with the unweighted coefficient of variation are given in Table 6 (Appendix I). These values are graphed in Figure 2.4.1. From this data it can be seen that there is considerable regional variation in employment as a percentage of population (with the Atlantic and Ontario regions showing the largest deviations from the Canadian average). But there is no significant long-run trend in the regional dispersion of the employment base. The coefficient of variation in the early 1950's was about the same as that for the late 1960's. The slight rise in inequality during the intervening years was largely due to an increase in the Prairie's employment base and a fall in that of British Columbia.

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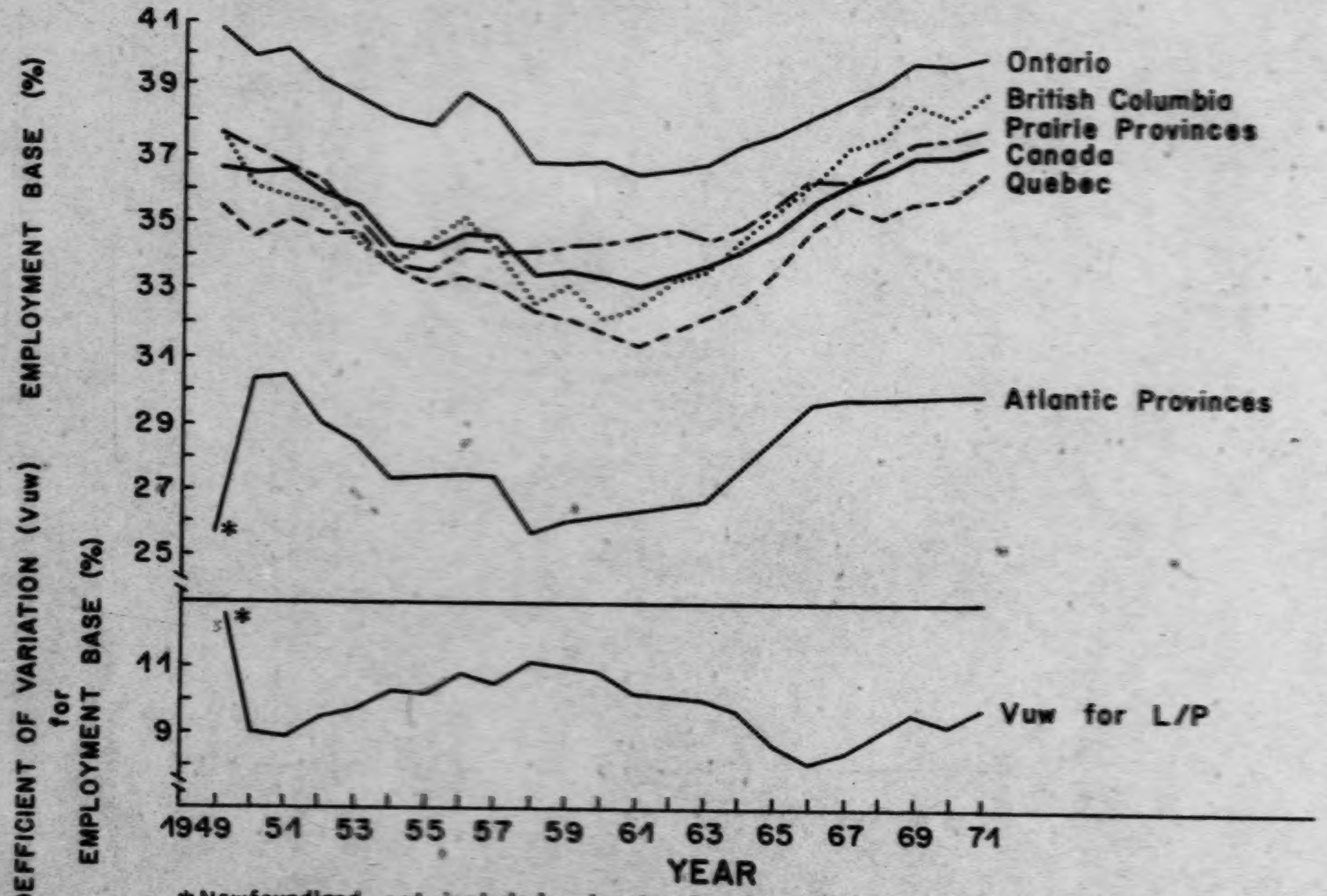
[1] The regional employment base is defined as regional employment as a percentage of regional population.



*Newfoundland not included prior to October 1949.
Source: Table 6, Appendix I.

FIGURE 2.4.1

EMPLOYMENT BASE BY REGION AND COEFFICIENT OF VARIATION OF REGIONAL EMPLOYMENT BASES, 1949-1971

Over the 1949-1971 period all regions tended to follow the "U" shaped pattern for the national employment base. This particular pattern was due to a fall and subsequent rise in the proportion of the population in the working age categories, coupled with high unemployment during the late 1950's and early 1960's.

The general long-run constancy in regional inequality in employment bases could either be due to a general constancy in the regional dispersion of unemployment rates, participation rates and age distributions or offsetting changes in the dispersion of these factors. In an attempt to determine which of these explanations is valid the long-run trend in the regional dispersion of each of these factors was analyzed. On the basis of this analysis, which is not reported here, it was concluded that there was a general constancy in the dispersion of regional participation rates, a general constancy or possibly a slight decrease in the dispersion of regional unemployment rates and a continual but slight decrease in the dispersion of regional age distributions. The slight levelling in regional age distributions along with the possible slight levelling in the dispersion of regional unemployment rates did not significantly affect the trend in inequality in regional employment bases because of the peculiar interaction of these factors across regions. While Ontario improved its relative position with respect to unemployment rates its age distribution regressed towards the national average. Similarly, while the participation rate in British Columbia rose towards the national average its age distribution fell toward the national average. The improvement in Quebec's relative age distribution was offset by a fall in its relative position with respect to participation rates. Finally, a slight rise in the Prairie's relative participation rate was offset by an equally slight deterioration in its relative age distribution.

2.4.3 AN ANALYSIS OF THE TREND OF REGIONAL INEQUALITY IN EARNINGS PER WORKER, 1949-1971

Using earned income per worker as a measure of earnings per worker and a five region breakdown the regional relatives were calculated along with the coefficient of variation. These figures are presented in Table 7 (Appendix I) and graphed in Figure 2.4.2.

As can be seen from the index of dispersion there has been some levelling over the period 1949-1971 in regional inequality in earnings per worker. This has been the main reason for the slight convergence of regional earned income per capita noted previously. It is important to note however, that the observed convergence of regional earnings is almost entirely due to a steady and quite rapid decline in British Columbia's relative position.[1] The relative positions of the other four regions have remained fairly constant over this period.[2]

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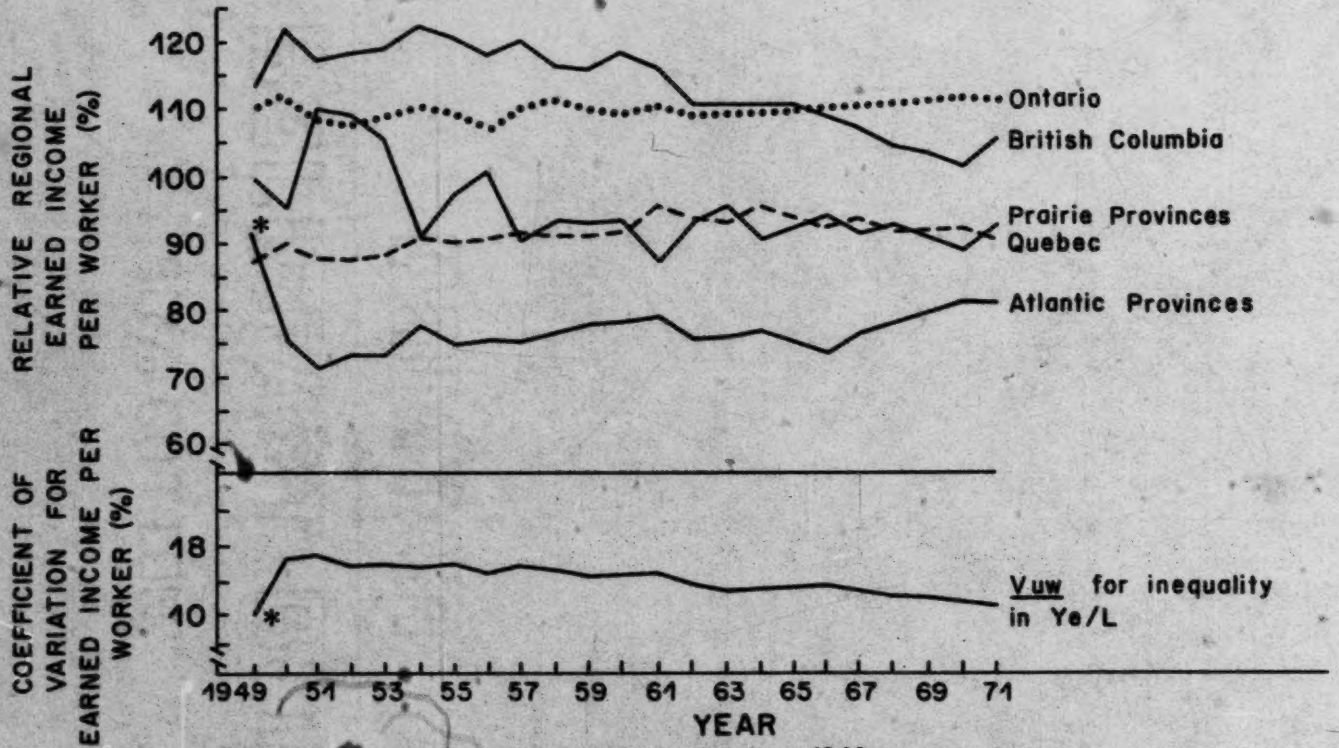
[1] A regression analysis indicates that British Columbia's relative position in terms of earnings per worker fell by about 0.76 of one percentage point per year over this period.

[2] It will be recalled that while the bulk of regional variations in earnings is unaccounted for, regional differences in such factors as rural-urban population distributions, age distributions of the labor force and education of the labor force statistically account for part of this inequality. An analysis of the long-run trends in these factors revealed that with the exception of inequalities in rural-urban distributions (in which case there has been some levelling), inequalities in these factors have remained more or less constant over time.



* Newfoundland not included prior to October 1949.
Source: Table 7, Appendix I.

FIGURE 2.4.2

REGIONAL EARNED INCOME PER WORKER AS A PERCENTAGE OF THE NATIONAL AVERAGE AND COEFFICIENT OF VARIATION OF EARNED INCOME PER WORKER, 1949-1971

Two cases of particular interest with regard to earnings differentials are Nova Scotia and Alberta. Because certain data required to test the model of regional adjustment set out in Chapter IV are available for these provinces, and because they represent interesting cases in terms of economic adjustment, they will form the basis of the explanation of Canadian trends of regional inequality proposed in this thesis. It is therefore appropriate at this point to look at the long-run trends of the earnings positions of these two provinces.

Using estimated employment for Alberta and Nova Scotia[1] and data on earned income for the respective provinces, earned income per employed worker in each province as a percentage of that for Canada was calculated for the period 1950-1971. These figures are presented in Table 8 (Appendix I). Considering first the case of Nova Scotia, there is no convincing evidence of either a convergent or divergent trend. While its relative position in terms of earnings per worker shows some improvement towards the end of the period this change is within the year-to-year variations throughout the period. Furthermore, rough estimates of employment in Nova Scotia in 1949 produce a level of relative earnings close to that in 1970.[2]

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[1] See Chapter V, Section 5.2.2.

[2] It must be stressed that in the cases of both Nova Scotia and Alberta conclusions about the long-run trend depend critically on the end-points and hence one can be easily misled by the data in Table 8 (Appendix I). Because of this sensitivity and the lack of well defined criteria for choosing end-points for these cases it was felt that little could be gained from a statistical analysis of the data.

The long-run trend for earnings in Alberta relative to that for Canada is also probably best interpreted as one of relative constancy. As noted in earlier sections, although there appears to be a downward trend in Alberta's relative position this is largely due to the exceptionally strong performance of the agricultural sector during the early 1950's. If the last year in the sample reflected equally buoyant conditions this trend would not be apparent.[1] It is also possible that the higher-than-average earnings position in the early 1950's and the subsequent fall to below-average represents some short-run adjustment to the large scale investments related to the development of the oil and gas industry in Alberta.

It is also worthwhile to note that in terms of the relative positions with respect to employment bases of these provinces, (see Table 8, Appendix I) there has been little change over the period 1950-1971. In the case of Alberta the long-run trend has been almost perfectly constant.

2.5 SUMMARY AND CONCLUSIONS

On the basis of the foregoing analysis several conclusions can be reached. First, any levelling in Canadian regional income inequality has been slight. When major disruptions in the economy over the period 1926-1971 are taken into account the long-run decline in regional inequality as measured by the coefficient of variation is about one-tenth of one percentage point per year. If the experience of other developed countries in this respect is used as a benchmark this levelling appears relatively unimportant.

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[1] Compare Table 2.3.2 and Table 2.3.5 above. When the longer period is used, there is no significant increasing or decreasing trend in Alberta's relative income position.

Second, the long-run trend in regional income inequality depends to some extent on the income measure used. When earned income per capita is used the amount of levelling is less than when personal income per capita is used. This suggests that there has been a slightly greater decline in regional inequalities in welfare than in economic activity or participation. Clearly, it is the latter type of change which is relevant to the predictions of most models of economic adjustment.

Third, what little decrease there has been in the degree of Canadian regional inequality has been almost entirely due to a fall in British Columbia's relative income position and a rise in Newfoundland's. This change in Newfoundland's position may in part reflect an adjustment towards a new equilibrium upon entering Confederation. While there have been some slight changes in the relative positions of some of the remaining provinces, for the most part there has been a remarkable stability in their long-run positions. In fact, if changes in earned income per capita are used as a measure of economic adjustment most of the provinces display a constant trend in relative income per capita.

Fourth, much the same patterns hold with respect to trends in regional inequalities in employment bases and earnings per worker as with inequalities in earned income per capita. There has been a constant trend in regional variations in employment bases over the period 1949-1971. The slight levelling in regional inequality in earned income per worker observed over the period 1949-1971 has been almost entirely due to a steady deterioration in British Columbia's above-average relative position. The remaining regions, including the special cases of Alberta and Nova Scotia, appear to have maintained a fairly stable relative position in terms of earnings per worker over this period.

In light of the above then, the trend in Canadian regional inequality is probably best interpreted as some type of long-run equilibrium where the individual cases of British Columbia and Newfoundland constitute exceptions. No attempt is made in this study to explain these exceptions; rather, attention is devoted to explaining what appears to be a relative stability in the positions of most of the regions.

Given this interpretation, any explanation of the lack of substantial change in the degree of Canadian regional inequality must involve an explanation of the lack of significant change in inequalities in both employment bases and earnings per worker. Such explanations however must be built on a solid theoretical foundation. While there is at present a significant amount of literature relevant to regional adjustment in earnings per worker, there is very little relevant to regional adjustment in employment bases. In fact, it has only been very recently that some attention has been focused on the causes of regional differences in such factors as participation rates and age distributions.[1]

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[1] See for example, Neil Swan, "The Response of Labour Supply to Demand in Canadian Regions," Canadian Journal of Economics, 7, (August, 1974), pp. 418-433, and Frank T. Denton and Byron G. Spencer, "Analyzing the Economic Effects of Changes in Fertility: A Simulation Approach," Working Paper No. 73-06, (Hamilton, Ontario: McMaster University, June, 1973), pp. 1-34.

Given the confines of this thesis and this lack of an adequate theoretical foundation then, attention is limited to an explanation of the long-run trend in regional earnings inequalities. It is worth noting, however, that such an explanation should go a long way toward understanding the trend in regional income inequality since about three-fifths of this inequality is due to this factor. The following Chapter is devoted to summarizing the theoretical aspects of regional earnings adjustment.

CHAPTER III

THEORETICAL ASPECTS OF REGIONAL WAGE ADJUSTMENT

3.1 THEORIES OF ECONOMIC ADJUSTMENT

In this chapter the long-run trends in Canadian regional wage and income inequality set out in Chapter II are related to various economic theories which have been or can be advanced to explain regional economic adjustment. Particular attention is paid to evaluating each of the theories within the context of the problem as set out in Chapter I. This summary and critique suggests the most important avenues of regional adjustment and indicates the basic requirements of a more adequate and realistic model of regional adjustment. Such a model is presented in Chapter IV.

Regional economic adjustment generally involves one or a combination of interregional flows of goods, people, funds and technology. These in turn are interrelated with adjustments in other variables, the most important of which include regional wage rates, price levels, terms of trade, unemployment rates and returns on investments.

There are numerous strands of economic theory relevant to regional adjustment and each places a slightly different emphasis on the economic variables and the chain of events involved in the adjustment process. For this reason there appears to be no "best" classificatory scheme for summary purposes. The somewhat arbitrary classification used here discriminates among theories which emphasize commodity trade in the adjustment process, those which emphasize factor mobility in the adjustment process, and those which combine both.

3.2 THEORIES OF ADJUSTMENT WHICH STRESS COMMODITY MOVEMENTS

3.2.1 TRADE THEORY

Although trade theory was developed to explain international trade in goods and services it is in some ways better suited to explaining interregional trade.[1] There are two basic types of trade theory: the Classical or Ricardian theory and the Hechscher-Ohlin theory. Within the Ricardian theory[2] trade among regions is determined according to comparative advantage, which results from differences in relative efficiencies in production due to regional differences in factor inputs or technology. Although this theory predicts higher per capita incomes for the region with the greatest absolute advantage, this prediction is based on a model which neither explains how a region comes to have a comparative advantage in certain products and how this may change over time, nor takes account of interregional movements of capital and labor.

The Hechscher-Ohlin (H-O) theory has largely supplanted the classical trade theory. Not only does it predict the commodities which a region will specialize in but it is quite amenable to various extensions. This theory argues that given certain assumptions[1] regions will tend to specialize in those commodities which use its relatively abundant factors most intensively in their production.

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[1] For arguments along these lines see J.R. Marooney and J.M. Walker, "A Regional Test of the Hechscher-Ohlin Hypothesis," Journal of Political Economy, 74, (December, 1966), pp. 573-586.

[2] For a summary of this theory in a regional context see, A.D. Scott, "Policy for Declining Regions: A Theoretical Approach," in Areas of Economic Stress in Canada, edited by W.D. Wood and R.S. Thoman, (Kingston, Ontario; Industrial Relations Centre, Queen's University, 1965).

In addition to showing the realism of many of the assumptions of the H-O theory in a regional setting, Marooney and Walker[2] have attempted a regional test of the theory using U.S. data and found some support for a regional version of the theory. Specifically, they found that on the basis of a North-South breakdown there tends to be an inverse rank correlation between industry capital-labor ratios and changes in the corresponding industry location quotients.

The main attractiveness of the H-O theory in relation to the problem of regional inequality lies in the extensions which give predictions about factor price movements. Samuelson[3] proved that under the H-O theory factor price equalization would result even in the complete absence of factor movements. He assumed two goods and two factors, perfect competition, irreversible factor intensities at all factor price ratios, diminishing marginal returns in the production of all goods, identical linear homogeneous production functions for each good in both regions (countries) and no complete specialization. If complete specialization is allowed, factor prices will not be completely equalized across all regions but there will be a tendency towards such equalization.

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[1] These are conveniently summarized in R. Caves, Trade and Economic Structure, (Cambridge, Mass.: Harvard University Press, 1960).

[2] Marooney and Walker, " A Regional Test of the Hechscher-Ohlin Hypothesis," p. 581.

[3] P.A. Samuelson, "International Trade and Equalization of Factor Prices," Economic Journal, 58, (June, 1948), pp. 163-184.

Many of the assumptions in the factor price equalization theorem are extremely restrictive even for the regional case. Relaxing some of these assumptions and allowing for transportation costs, differences in regional production conditions for similar goods and regional differences in the quality of factors of production would mean incomplete equalization.

Perhaps the most unrealistic assumption of the regional variant of this theorem is that of regional factor immobility. In a regional context capital and labor are usually highly mobile and can form a substitute for commodity movements. Mundell[1] considered the case of factor mobility and commodity immobility, and showed that given a set of assumptions similar to those embodied in the factor price equalization theorem, and given an initial inequality in factor prices, factors would move so as to equalize factor prices, commodity prices and eliminate further factor movements. With this approach the existence of migration costs or costs associated with capital movements would prevent complete factor price equalization.[2]

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[1] R.A. Mundell, "International Trade and Factor Mobility," American Economic Review, 47, (June, 1957).

[2] See L. Lefeber, Allocation in Space: Production, Transport and Industrial Location (Amsterdam: North Holland Publishing Co., 1958). Using a similar model, he shows that with transportation costs, regional factor prices would differ in equilibrium by the marginal cost of moving one unit of the factor from one region to the other.

In reality the regional case lies somewhere between the two extreme cases considered by Samuelson and Mundell. There is both substantial but imperfect factor mobility and a close approximation to free commodity trade. It would be reasonable to expect that if the basic assumptions of the equalization theorems hold, then the movement towards equalization of factor returns should be much more rapid and much more complete in the regional case as compared to the international case.[1]

A major weakness of the trade theory outlined above for the purpose of understanding regional adjustment is that the problem is of a dynamic nature while the theory is largely framed in static terms. While the technology of production along with the quantities and qualities of factors of production are given and fixed in the theory, factor price movements occur in a world where factors of production change and grow, resources are depleted and new ones are discovered, technologies change and are accepted and implemented at different rates across regions, and where demands and tastes constantly change.[1]

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[1] It is worth stressing at this point that although the simple trade models generally suggest a tendency for the equalization of factor prices, this does not necessarily imply equalization of per capita incomes. Even if prices for homogeneous factors were equalized across all regions, regional differences in factors such as participation rates, unemployment rates and per capita ownership of factors (with respect to both quality and type) would produce disparities in per capita incomes. In the Canadian case however, a substantial portion of the regional inequality in per capita income is due to differences in basic rates of pay across regions for similar skills and occupations. In this case the equalization of factor prices should produce a tendency toward equalization of per capita incomes.

3.2.2 INCOME THEORY

Various macroeconomic models of income determination have been adapted to the regional case.[2] The two most common adaptations are those involving the Classical and Keynesian approaches to income determination. In both cases regions are viewed as being linked primarily through interregional trade and hence most adjustments are through the balance of payments which in turn involve adjustments in regional factor and commodity prices or unemployment.

Within a classical framework wages and prices are assumed to be flexible, responding quickly to changes in supply and demand. If labor is immobile interregionally any disequilibrium will be corrected by changes in regional wages and prices. To illustrate, if a region suffers a decline in its exports it is predicted that the resulting excess supply of labor will have two effects. First, as wages in the exporting sector fall there will be worsening of the regions terms of trade tending to encourage exports from the region and to discourage imports to the region. Secondly, the fall in the regions wage level will tend to raise the return on investments in the region, producing a capital inflow. These two effects will restore the balance of payments equilibrium and arrest any further divergence in regional wage rates.

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[1] It should be noted that several attempts have been made to take account of these types of factors. See, for example, Irving B. Kravis, "'Availability' and Other Influences on the Commodity Composition of Trade," Journal of Political Economy, 64, (April, 1956), pp. 143-145.

[2] See, for example, H.W. Richardson, Regional Economics, (London: Weidenfeld and Nicolson, 1969), pp. 247-286.

Within the classical framework there is no requirement for factor price equalization. In fact, without labor mobility a divergence of relative real regional wage levels would be expected to result from any continuous fall in the demand for a particular region's exports. In the more realistic case where labor mobility is allowed, however, if migration is economically motivated and sufficiently responsive to any differences in real regional wages in excess of migration costs, the movement of people from the low-real-wage regions to the high-real-wage regions will produce a tendency toward the equalization of real wages.

The second main type of model of income determination is that associated with Keynes. Within a Keynesian framework wages and prices are assumed downwardly rigid. Using the example of a decline in a region's exports, the fall in aggregate demand would produce a multiplied decrease in regional income and an increase in unemployment in the region, both tending to discourage imports and thereby restoring the balance of payments equilibrium and preventing any divergence of regional wage rates. This adjustment would be aided by the private net asset drain from the region required to finance the temporary deficit.

While these simple models emphasize forces for regional balance of payments equilibrium, they ignore the possibility that a Balance of Payments deficit could be maintained over the long-run through government interregional transfers. What little evidence there is would suggest that this may not be unreasonable for the Canadian case.[1] In such a case interregional transfers which tend to allow regional long-run balance of payments disequilibrium situations to persist prevent the changes in regional wages, incomes or unemployment required for the adjustment to be complete.

Both the Classical and Keynesian models of income determination stress factors which are important in short-run variations in income. As such they have limited applicability to the problem of long-run regional wage and income inequality. Further, they largely ignore interregional factor mobility.

3.2.3 DEMAND DOMINATED GROWTH THEORY

There are numerous growth theories applicable to the regional economy. For the most part, theories of regional growth can be characterized as being either demand or supply dominated. The former types are generally most applicable to lagging regions while the latter are generally most applicable to rapidly growing regions. One of the simplest demand dominated theories is the export base theory of regional growth. It argues that the rate of growth of regional income is dependent on the rate of growth of the region's export base which in turn is dependent on the growth in demand for the region's exportable production.[2]

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[1] See Chapter IV, section 4.2.

[2] For applications of this model, see R.E. Bolton, Defense Purchases and Regional Growth, (Washington, D.C.: Brookings Institution, 1966); Fredrick Bell, "An Econometric Forecasting Model For A Region," Journal of Regional Science, VII, (1967), pp. 109-127; and John Vanderkamp, "The Effect of Out-Migration on Regional Employment," Canadian Journal of Economics, III, (November, 1970), pp. 541-549.

Such a simplified theory is not without serious weaknesses [1] however, most important of which are its lack of consideration of the possibility of endogenously generated growth and its failure to explicitly take account of interregional linkages. With respect to the latter, it does not take account of the fact that an increase in exports from one region means an increase in imports to another which through its effects on the second region will in turn affect exports from the first region.

A much more sophisticated group of demand dominated models are those characterized as Harrod-Domar (H-D) models. A regional variant of a H-D model has been set out by Richardson.[2] For the most part meaningful statements about regional adjustment on the basis of the H-D type of model can only be made if an equilibrium condition requiring all regions to grow at identical rates is assumed.[3] This, however, is tantamount to assuming away the problem of explaining the long-run trend in regional growth. In the absence of such a restriction all that can be said is that regions with net import surpluses and net immigration should tend to grow faster than regions with net import deficits and net emigration.

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[1] See M.D. Thomas, "The Export Base and Development Stages Theories of Regional Economic Growth," Land Economics, 40, (November, 1964), pp. 421-432.

[2] Richardson, Regional Economics, pp. 323-331.

[3] This is largely a result of the extremely restrictive assumption of fixed production coefficients.

3.3 THEORIES OF ADJUSTMENT WHICH STRESS FACTOR MOVEMENTS

3.3.1 THE BASIC THEORY OF MIGRATION

Although there are many statements concerning interregional labor migration in the literature there does not appear to be a summary of the theory which is useful for the purposes at hand.[1] This first section is therefore devoted to summarizing several important strands of the theory. This summary begins with a partial analysis of migration in which interregional earnings differentials at any point in time are given. These differentials are initially viewed as constituting a state of disequilibrium and within this framework migration is viewed as being a response to this state of disequilibrium.

Not only does migration theory typically emphasize the importance of economic factors among the determinants of interregional migration, but empirical studies have provided considerable support for this notion.[2] Of the economic factors the most important determinants of migration tend to be the potential for improvement in income or earnings positions and employment opportunities.[1]

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[1] One of the most complete summaries is G. Sahota, "An Economic Analysis of Internal Migration in Brazil," Journal of Political Economy, 76, (March, April, 1968), pp. 218-245. The seminal article in this area is L.A. Sjaastad, "The Costs and Returns of Human Migration," Journal of Political Economy, 70, Supplement, (October, 1962), pp. 80-93.

[2] See for example, May Nickson, Geographic Mobility in Canada, October, 1964-October, 1965, DBS, Special Labor Force Study No. 4, (1967). The author found that over 70% of all migrants surveyed reported economic motives for moving. Other recent empirical studies of Canadian interregional migration include: John Vanderkamp, "Interregional Mobility in Canada: A Study of the Time Pattern of Migration," Canadian Journal of Economics, I, (August, 1968), pp. 595-608; T. Courchene, "Interprovincial Migration and Economic Adjustment," Canadian Journal of Economics, III, (November, 1970), pp. 550-576; C. Laber and R.X. Chase, "Inter-Provincial Migration in Canada as a Human Capital Decision," Journal of Political Economy, 79, (August, 1971), pp. 795-804.

If consideration is initially limited to interregional wage differentials it is reasonable to postulate that in a two region system net migration from region 1 (the low wage region) to region 2 (the high wage region) is positively related to any excess of the potential earnings differential between the two regions over the costs of migration. Symbolically:

$$3.3.1 \quad M_{1t} = f[(w_{2t}-w_{1t}) - C];\ f' > 0;$$

where M_{1t} is the rate of net emigration from region 1 to region 2 in period t, w_{it} is the wage rate or earned income per worker in region i in period t, and C represents the costs associated with migration. This may be written more compactly as:

$$3.3.2 \quad M_{1t} = f(\theta_{1t}-C);$$

where $\theta_{1t} = (w_{2t}-w_{1t}) \geq 0$.

Following Sahota,[2] C is assumed to consist of: (i) money costs in the form of increased expenditure on food, lodging and transport, (ii) non-money costs in the form of income foregone during the period while travelling, searching for, or learning a new job, and (iii) psychic costs associated with such things as changing lifestyles and homesickness. The second cost component is essentially an opportunity cost and as such will bear some relation to earnings in the migration sending region. If this cost is relatively important in relation to total costs the appropriate specification of the migration function will stress relative rather than absolute earnings differentials as in 3.3.1. That is, given that α is some constant and αw_{1t} represents the opportunity costs associated with migration, these additional costs can be incorporated in 3.3.1 to get:

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[1] It should be noted that the primary concern here is with the determinants of the magnitude of interregional migration over time rather than with the cross-sectional nature of migration (where for example, factors such as geographical distance would be important).

[2] G. Sahota, "An Economic Analysis of Internal Migration in Brazil," p. 219.

$$3.3.3 \quad M_{1t} = f[(w_{2t} - w_{1t}) - (C + \alpha w_{1t})];$$

which can be rearranged to get:

$$3.3.4 \quad M_{1t} = f(\frac{w_{2t} - w_{1t}}{w_{1t}} - C'); \text{ where } C' = \frac{C}{W_{1t}} - \alpha.$$

These migration functions could be cast in either a linear or a non-linear form.

3.3.2 EXPECTED EARNINGS DIFFERENTIAL MIGRATION FUNCTIONS

In most cases the appropriate earnings variable in the migration function will be the expected earnings differential since the probability of capturing higher wage jobs through migration is generally less than one. Thus 3.3.2 might be revised to:

$$3.3.5 \quad M_{1t} = f[P_{2t}(w_{2t} - w_{1t}) - C];$$

$f' > 0$; where P_{2t} is the probability of capturing a high wage job in region 2. If it is assumed that migrants initially join the pool of unemployed workers and that the selection from this pool is random the probability of getting a job in region 2 will be proportional to the unemployment rate there.[1] That is, P_{2t} is proportional to $\frac{1}{U_{2t}}$ where U_{2t} is the unemployment rate in region 2 at time t.

This approach can be extended by taking into account any "push" factors associated with high unemployment in the sending region in addition to the "pull" factor associated with 3.3.5 above. That is, migration from region 1 to region 2 will not only depend on the probability of gaining a higher paying job in region 2, but also on the probability of losing and/or being unable to obtain further employment in region 1. Assuming that this latter probability is proportional to the unemployment rate in region 1,[2] the expected net gain from migrating (ENG_{1t}) is:

$$3.3.6 \quad ENG_{1t} = [(\frac{1}{U_{2t}} \cdot w_{2t}) - (\frac{1}{U_{1t}} \cdot w_{1t}) - C].$$

and,

$$3.3.7 \quad M_{1t} = f(ENG_{1t});\ f' > 0.$$

It is important to note that under 3.3.7 an infinite elasticity of migration with respect to current earnings differentials would only be possible with zero regional unemployment.[1] In addition it should be noted that if per capita income rather than wage differentials are used in the migration function regional variations in unemployment rates are taken account of implicitly. That is, even though regional wage differentials remain constant an increase in unemployment differentials implies an increase in per capita income differentials.

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[1] A similar approach is used by M. Todaro, "A Model of Labor Migration and Urban Unemployment in Less Developed Countries," American Economic Review, 59, (March, 1969), pp. 138-148.

[2] Actual unemployment rates may not be the best indicator of labor market conditions when the migration decision is made because such migration may affect the level of regional unemployment. That is, the appropriate measure is unemployment ex ante rather than ex poste. See, G. Blanco, "Prospective Unemployment and Interstate Population Movements," Review of Economics and Statistics, 46, (May, 1964), pp. 221-222.

A somewhat different method of incorporating expected earnings differentials into the migration function is embodied in the human capital approach to migration associated with Schultz and Sjaastad.[2] This approach, which is based on the neoclassical theory of investment, assumes migrants base their decision to migrate on a benefit-cost calculation, weighing the stream of expected future earnings differentials against the costs. Using a continuous type of analysis, the migration function based on this approach is:

$$3.3.8 \quad M_{1t} = f(V_{1t}^{*} - C); \; f' > 0;$$

where $V_{1t}^{*} = W_{2t}^{*} - W_{1t}^{*}$ = the difference between the expected present value of the future stream of earnings in region 2 and region 1. W_{2t}^{*} and W_{1t}^{*} are given by:

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[1] It is interesting to note that much of the empirical work on migration involves unemployment rates entering the equation in additive fashion. See for example, Courchene, "Interprovincial Migration and Economic Adjustment," and Vanderkamp, "Interregional Mobility in Canada: A Study of the Time Pattern of Migration." This however, is inconsistent with the specification given here and in some cases with the researcher's own specification.

[2] T.W. Schultz, "Investment in Human Capital," American Economic Review, 51, (March, 1961), pp. 1-17. Sjaastad, "The Costs and Returns of Human Migration."

$$3.3.9 \quad W^*_{it} = \int_t^{t+n} w^*_{it}\, e^{-r(s-t)} ds;$$

where i = 1, 2; $t < s < t+n$, and r = discount rate, n = migrants time horizon, s = time within the time horizon and w^*_{it} = expected stream of future earnings in region i.[1]

If it is assumed that all migrants' expected wage differentials are the same for all future time periods the migration function will be:

$$3.3.10 \quad M_{1t} = f\left[\frac{1-e^{-rn}}{r}\, \theta^*_{1t} - C\right];$$

where $\theta^*_{1t} = w^*_{2t} - w^*_{1t}$.

This approach to migration yields several interesting results. First, since in most cases the time horizon is related to the expected working life of migrants it suggests that the strongest migration response to earnings differentials will be among the younger, skilled workers.[2] Thus, this approach can not only explain the selective nature of migration but also an imperfect migration response to earnings differentials. Second, this approach indicates that migration motivated by economic factors may be expected even though current earnings differentials do not exceed the costs of migration. Third, whether expectations with respect to future earnings are extrapolative or regressive this approach stresses the importance of past earnings differentials in the migration decision.

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[1] For an attempt to estimate w^*_{it} see N.M. Hansen, "Migration Centres, Growth Centres and Regional Commissions: An Analysis of Expected Future Lifetime Income Gains to Migrants From Lagging Regions," Southern Economic Journal, 38, (April, 1972), pp. 508-517.

[2] Mathematically, $\frac{dV^*_{1t}}{d_n} = \theta^*_{1t}\, e^{-rn} > 0$.

There are still other directions in which the above migration functions may be extended. Several of these are related to the theories of the late 19th and early 20th century British economists, notably Ravenstein and Redwood.[1] According to their approach there are certain "laws of migration" involving both "push" and "pull" factors. These "push" - "pull" factors are not limited to regional differences in income and employment opportunities. They may include factors such as an unfavorable change in the region's terms of trade, outmoded land-tenure systems, or the "bright lights" of the large cities and towns. Within this theory it is quite plausible that migration will occur in many cases despite the fact that the migrants' economic position may be worse in the new region.

Numerous variables can be added to the above specifications to take account of the loosely defined "push" - "pull" factors stressed in the classical theory. Some of these might be:

(i) the level of urbanization in the receiving region relative to that in the sending region as a proxy for the pull of the "bright lights."

(ii) the rate of investment in the receiving region relative to that in the sending region as a measure of the "pull" associated with the growth of labor demand.

(iii) the growth of income, wages, or employment in the receiving region relative to that in the sending region as a measure of expected opportunities.

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[1] E.G. Ravenstein, "The Laws of Migration," Journal of the Royal Statistical Society, 22, (1885), pp. 167-227; A. Redford, Labor Migration in England, 1800-1850, (Manchester: University Press, 1926).

(iv) the percentage change in the proportion of the labor force employed in agriculture. The hypothesis here is that the greater the exodus from agriculture (brought about by rapid technological changes in the industry), the greater is the pressure on the supply side of regional labor markets and hence the more powerful the "push" factors in the region.

(v) the natural rate of increase in the region. Inclusion of this variable is based on the idea that the greater the increase in the indigenous labor supply, the greater is the pressure on the supply side of regional labor markets and the greater the "push" for out-migration.

3.3.3 INTERREGIONAL MIGRATION AND WAGE ADJUSTMENT

Models of interregional migration have typically been limited to a consideration of the "causes" of migration. As such, they are of limited value when it is recognized that migration may also "affect" the explanatory variables (such as unemployment rates and earnings differentials) in the migration function. R.F. Muth,[1] for example, has argued that because these models do not take account of both the "cause" and "effect" nature of migration they are inadequate even from the point of view of identifying the true causes or determinants of migration.

While it seems reasonable that migration has important effects on the regional economy there are no clear indications as to which variables are most significantly affected[1] or the direction of the effects. Part of the problem here is that the effects of migration will depend on both the characteristics of the migrants and whether the concern is with short-run or long-run effects.[2] To the extent that interregional migration is highly selective with respect to age and education it will not only affect economic variables such as quantity and quality of the labor force, participation rates, and unemployment rates, but will also affect demographic variables such as the age-sex distribution of the population and natural rates of increase. Changes in both of these types of variables will affect regional wage and income inequality. Even when the time horizon for the analysis is fixed there are problems in determining the effect of migration on the economic variables. While it has been argued, for example, that in the short-run the main effect of migration is on regional unemployment rates, there is some question as to whether or not the direction of the effect will be favorable.[3] In this regard, recent work by Vanderkamp[4] suggests that with the existence of large transfer payments to the Maritime region, outmigration, through the multiplied effects of a removal of autonomous aggregate demand, actually increases unemployment in the region.

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[1] R.F. Muth, "Migration: Chicken or Egg," Southern Economic Journal, 37, (January, 1971), pp. 295-306.

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[1] For a discussion of the variables which might be affected by immigration see Melvin W. Reder, "The Economic Consequences of Increased Immigration," Review of Economics and Statistics, 45, (August, 1963), pp. 221-230.

[2] See B. Okun and R.W. Richardson, "Regional Income Inequality and Internal Population Migration," Economic Development and Cultural Change, 9, (January, 1961), pp. 129-130.

[3] R.G. Gold, "Interregional Factor Transfers and Regional Unemployment," Journal of Political Economy, 76, (March/April, 1968), pp. 246-251.

[4] John Vanderkamp, "The Effect of Out-Migration on Regional Employment," Canadian Journal of Economics, III, (November, 1970), pp. 541-549.

Within a long-run framework it is reasonable to assume that the main effect of interregional migration is on regional wage rates. In this case regional wage adjustment through migration is usually demonstrated using a static labor demand - labor supply model. The model assumes a two region system where labor demand in each region is (given the state of technology, the demand for the region's output and the region's terms of trade) a function of the regional wage rate. It is also assumed initially that regional labor demand functions do not shift, that the indigenous labor supply for each region is inelastic with respect to the wage rate and that the total labor supply available to the two regions is fixed.

Now in the absense of migration costs, an initial wage differential $(w_2 - w_1) > 0$, would constitute an incentive for migration from region 1 to region 2. This migration, by increasing the labor supply in region 2 and decreasing the labor supply in region 1, would tend to equalize wages in the two regions. The long-run equilibrium in this case will be where the regional wage rates are equal. If migration costs are incorporated into the analysis, however, the long-run equilibrium will be where interregional migration is zero and where,

3.3.11 $w_1 + C = w_2$;

where C = costs of migrating from region 1 to region 2.[1]

This static analysis of regional wage adjustment leads to several interesting results. First, it indicates that the existence of migration costs is sufficient to prevent complete regional wage equalization. Secondly, it suggests that the long-run equilibrium will be characterized by constant regional wage differentials equal to the cost of migrating between the two regions and a zero level of interregional migration. Although this prediction of some long-run equilibrium level of regional wage differentials may at first suggest the relevance of the model in explaining Canadian long-run trends it should be realized that the requirement of zero migration is not realistic.[2] Furthermore, while the model predicts a long-run constancy in absolute wage differentials, what is in fact observed approximates a constancy in relative wage differentials. Thus it would appear that the static model is inappropriate for the study of Canadian regional wage inequality, and that a dynamic model is suggested. With respect to the latter, the assumptions of fixed regional labor demand functions and fixed aggregate labor supplies are much too restrictive in a long-run context.

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[1] Note that if a human capital approach to migration is assumed the long-run equilibrium wage differential could be less than C. For the case with an n period horizon, the equilibrium wage differential will be replaced with:

$$\frac{(W_2^* - W_1^*)_1}{(1 + r)^1} + \ldots + \frac{(W_2^* - W_1^*)_n}{(1 + r)^n} = \frac{C}{(1 + r)} \quad \text{or} \quad W_2^* = W_1^* + \frac{(1 + r)^{n-1} rC}{(1 + r)^{n-1}}$$

[2] See P.K. Gatons and R.J. Cebula, "Wage-Rate Analysis: Differentials and Indeterminancy," Industrial and Labor Relations Review, (January, 1972), pp. 207-212. On the basis of a static partial equilibrium model of wage behavior they conclude that persistent regional wage differentials are compatible with this conventional wage theory when a mobility constraint

3.3.4 SUPPLY DOMINATED GROWTH THEORY

In contrast to demand dominated growth theories supply dominated theories stress technological change and the growth of the supply of factors of production as the main determinants of regional growth. The regional variants of these theories are generally more complete in terms of including interregional linkages through goods and factors and are less restrictive in terms of the conditions for equilibrium growth than demand dominated theories. For these reasons they are generally better suited for studying regional inequality.

A simple supply driven model of regional growth relevant to the problem of regional inequality has been proposed by Klassen, Kroft and Voskuil.[1] It is summarized in equations 3.3.12 - 3.3.15 below.

$$3.3.12 \quad P_t \equiv P_{t-1} + NI_{t-1} + M_t$$

$$3.3.13 \quad M_t = \alpha(Y_t - \bar{Y}_t);\ \alpha > 0$$

$$3.3.14 \quad L_t^D = \beta_1 Y_t + \beta_2 Z_t + \beta_3 A_t;\ \beta_1 < 0,\ \beta_2 > 0,\ \beta_3 > 0$$

$$3.3.15 \quad L_t^D = L_t^S = P_t;$$

where P_t is the working population of the given region in year t, NI_{t-1} is the natural increase in the labor force in the region in year t-1, M_t is net labor migration into the region; Y_t is income per worker in the

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is included. The authors do not, however, recognize that such an explanation of inequality implies the severe restriction of zero long-run interregional migration.

[1] L. Klassen, W. Kroft and R. Voskuil, "Regional Income Differences in Holland", Proceedings of the Regional Science Association, 10, (1963), pp. 77-78.

region, $\bar{Y}_t$ is the average income per worker in the nation, Z_t is a structural variable which affects regional labor demand (L^D_t) and is defined as the proportion of the working population in the region employed in agriculture, A_t is an agglomeration factor defined as the proportion of the regional population living in large regional centres, and L^S_t is the region's labor supply. Z_t and A_t are exogenously determined.

The solution to this model is:

$$3.3.16 \quad Y_t = \frac{P_{t-1} + NI_{t-1}}{\beta_1 - \alpha} - \frac{\beta_2 Z_t}{\beta_1 - \alpha} - \frac{\beta_3 A_t}{\beta_1 - \alpha} - \frac{\alpha \bar{Y}_t}{\beta_1 - \alpha} ;$$

where the assumed signs of the coefficients are: $\alpha > 0$, $\beta_1 < 0$, $\beta_2 > 0$, and $\beta_3 > 0$.

From the solution to this model it is evident that the level and pattern of regional inequality depends critically on the parameters α and β_1. In general, the larger is the migration response parameter, α, relative to the slope of the labor demand function, β_1, ceteris paribus, the lower the level of regional inequality. Further, it can be seen that whether or not changes in the exogenous variables (such as NI and $\bar{Y}$) have a favorable or unfavorable affect on regional inequality depends critically on the size of α. Only if α is large relative to β_1 will increases in the natural rate of increase or in the level of national income not produce a widening of regional earnings differentials.[1] In fact, if α is close to one growth in national income will produce a rapid convergence of regional per capita earnings. Within this model then, migration behavior is the single most important determinant of the levels of regional inequality.

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[1] That is, if α is large relative to β_1, $\frac{dY_t}{d\bar{Y}_t} = \frac{-\alpha}{\beta_1 - \alpha} > 1$.

Perhaps the most common supply dominated models of regional growth are those classified as neoclassical models. Two important underlying assumptions of these models are that there is a continuous function linking factor inputs to regional output and that factor inputs are allocated such that their marginal products equal their market prices. Given additional assumptions that the rate of technical progress within each region is a constant function of time and that there exists a constant returns to scale production function for each region it is possible to derive an equation of the form:

$$3.3.17 \quad \frac{\dot{Q}_i}{Q_i} = \alpha\frac{\dot{K}_i}{K_i} + (1-\alpha)\frac{\dot{L}_i}{L_i} + r;$$

where Q_i = real income or output in region i, K_i = real regional capital stock, L_i = regional labor input and r = rate of technical progress. Also $\dot{Q}_i = dQ_i/dt$ so $\dot{Q}_i/Q_i$ is the rate of growth of output. The other variables are similarly defined. α is capital's share of output.

For the two factor case of this model it can be seen that the rate of growth of output in each region will be determined by the rate of capital accumulation, the growth of the labor supply and what may broadly be called technical progress.[1]

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[1] This model has been found to explain the pattern of regional growth rates in the U.S. over the period 1929-59 with considerable accuracy. See, J.T. Romans, Capital Exports and Growth Among U.S. Regions, (Middleton, Conn.: Wesleyan University Press, 1965). This model has also been used to evaluate the determinants of Canadian regional growth. See for example, N.H. Lithwick, "Labor, Capital and Growth; The Canadian Experience," in T.N. Brewis, Growth and the Canadian Economy, (Toronto: McClelland and Stewart Ltd., 1968).

The neoclassical model summarized above does not take into account interregional linkages and therefore is of limited use in explaining patterns of regional inequality. This shortcoming, however, has been rectified in a recent extension of the neoclassical model by Sakashita and Kamoike.[1] In their model interregional mobility of both capital and labor is allowed and this mobility is assumed to be a response to regional differentials in factor earnings.

The Sakashita and Kamoike (S-K) model is built around a set of identical regional Cobb-Douglas production functions which are homogenous of degree one and which include two factors, capital and labor, as arguments.

Inequalities in the marginal products of factors across regions are defined as the difference between the marginal product of the factor in region i and a weighted average of the marginal products for that factor in the other regions. It is assumed that the two factors are mobile across regions, that there are no costs involved in these interregional factor movements, and that the factors move to the regions where their marginal products and hence returns are highest. Within the S-K model the growth of the factors is made up of two components: that resulting from internal growth and that resulting from interregional movements of factors.

As a measure of regional inequality, the authors define a relative variance index of per capita output. On the basis of this measure and the a priori restrictions on the parameters in the model, they show that there will always be a convergence of per capita output if the elasticity of output with respect to capital (α) satisfies the condition that $(1 - 2\alpha) \leq 0$. Alternatively, if this condition is imposed it can be shown that the requirement that labor migration is from the low to high return regions is sufficient to produce convergence. Further, in their model it can be shown that not only are interregional capital flows not necessary for convergence but also that convergence is possible even if capital flows are from the high return to low return areas so long as they are not so large as to outweigh the equilibrating influence of the interregional labor movements.

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[1] N. Sakashita and O. Kamoike, "National Growth and Regional Income Inequality," International Economic Review, 14, (June, 1973), pp. 372-382.

Another interesting result that can be derived from the S-K model is that regional inequality in per capita income will converge to zero. However, in the case where costs of interregional migration are incorporated into the migration function and where capital is imperfectly mobile it can be shown that in the limit the regional differential will equal the costs associated with interregional labor migration.

The S-K model is an important contribution in that it specifies the conditions for convergence in a dynamic framework and emphasizes the importance of interregional factor movements as determinants of long-run trends in regional inequality. To the extent that the model captures the most important economic adjustments in a regional economy and given the reasonableness of the conditions required for convergence it does emphasize the likelihood of decreasing regional inequality. The model is, however, incomplete from the point of view of explaining observed long-run trends in regional inequality in Canada since it does not yield useful information regarding the speed of convergence.[1] If it is rapid then the Canadian trend must be interpreted as one where some long-run equilibrium level of inequality has been achieved and is maintained. If on the other hand the speed of adjustment is extremely slow it must be interpreted as a situation in which the system is still converging to some equilibrium level of inequality but that many more decades will be required before this equilibrium is achieved. To a large extent the plausibility of each interpretation is an empirical question and one which is dealt with in the next chapter.

3.4 THEORIES OF ADJUSTMENT WHICH STRESS BOTH COMMODITY AND FACTOR MOVEMENTS

3.4.1 THE BORTS AND STEIN MODELS OF REGIONAL ADJUSTMENT

Several models incorporating dynamic elements along with both commodity trade and interregional factor mobility have been set out by Borts and Stein.[2] The Borts models,[3] which are fairly representative of these, are two sector-two region models. On the basis of these, Borts suggests that given an initial difference in money wages across regions equalization may not occur, (that is, the high-wage region may grow faster than the low-wage region) if: (i) there is a higher marginal efficiency of investment in the high-wage region than in the low-wage region due to either production functions which yield higher marginal products for both capital and labor in the high-wage region or a rise in the prices of the export commodities from the high-wage region relative to those from the low-wage region.

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[1] It should be stressed that this model is in many respects an over-simplification of the regional economy. Assumptions of identical regional production functions exhibiting constant returns-to-scale may be unrepresentative of the Canadian case.

[2] G.H. Borts and J.L. Stein, Economic Growth in a Free Market, (New York: Columbia University Press, 1964).

[3] See G.H. Borts, "The Equalization of Returns and Regional Economic Growth," American Economic Review, 50, (June, 1960), pp. 319-347.

(ii) for non-economic reasons people migrate to the high-wage region and the migrants transfer capital with them, or the migrants demand capital once they have completed the move.

(iii) residents of the high-wage region save a higher proportion of income and this is invested, for non-economic reasons, in enterprises within the region.

While the Borts models do indicate the possibility of non-convergence of factor prices the conditions for such are not clearly specified. For example, under (ii) it is not clear that the fact that migrants take capital with them or demand capital when they arrive is sufficient for migration not to tend to equalize factor prices across the regions. The basic problem here is that within such a simplified model no distinction is made between the direction and rate of factor movements and hence no clear predictions about convergence or divergence of factor prices can be made.

3.4.2 DISEQUILIBRIUM THEORIES OF REGIONAL ADJUSTMENT

The foregoing models have generally emphasized the equilibrating effects of interregional movements of people, capital and goods through the operation of the market mechanism. Several authors, most notably Myrdal[1] and Hirschman,[2] have attacked this equilibrium view of regional adjustment arguing that "the play of forces in the market tends to increase, rather than to decrease, the inequalities between regions."[3]

Both Hirschman and Myrdal (H-M) suggest that development begins in certain regions of a nation because of some locational advantage or because of some historical accident. Once one region has achieved a developmental advantage over the others certain forces are set into operation which are detrimental to these other regions. More specifically, this development produces harmful backwash or polarization effects through interregional movements of labor, capital, goods and services which are "the media through which the cumulative process evolves - upward in the lucky regions and downward in the unlucky ones."[4]

The basis of the H-M argument is that while emigration from a poor region tends to denude it of its key technicians and managers and its more enterprising young men the immigration to the expanding region produces both a highly skilled labor force and a rapid expansion in demand. At the same time capital movements to the expanding region spur investments such that the growth process becomes self-sustaining as internal and external economies are exploited. In the lagging region however, not only is there a tendency for the banking system to siphon off savings for the richer and more progressive regions where returns to capital are high and secure but also, through commodity trade, there is a tendency for it to lose income creating activities in manufacturing to the more efficient economy of the expanding region.

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[1] Gunnar Myrdal, Rich Lands and Poor, (New York: Harper and Row Co., 1957), Gunnar Myrdal, Economic Theory and Under-Developed Regions, (London: G. Duckworth, 1957).

[2] A.A. Hirschman, The Strategy of Economic Development, (New Haven: Yale University Press, 1958). See also, R.B. Hughes, "Interregional Income Differences: Self Perpetuation," Southern Economic Journal, 28, (July, 1961), pp. 41-45.

[3] Myrdal, Economic Theory and Under-Developed Regions, p. 26.

[4] Myrdal, Rich Lands and Poor, p. 27.

Within the H-M framework there are some favorable spread or trickling-down effects opposing the backwash effects. These forces involve the increases in purchases and investments by the expanding region in the lagging region and the absorption of disguised unemployment in the lagging region which tends to raise labor productivity and per capita consumption. It is argued however, that increasing regional inequality will generally be observed because the backwash effects are usually stronger than the spread effects. The fact that this increasing inequality is not observed in more developed nations is, according to Myrdal, due to the fact that interferences with the market mechanism extended by the central government more than compensate for the backwash effects.

Although the H-M approach to regional adjustment is potentially enlightening as a result of its suppression of the concept of a stable equilibrium and the "equality doctrine" (the separation of economic and non-economic variables and the abstraction from the latter), it is so loosely specified that in its present form it yields little by way of an explanation of patterns of regional inequality.[1] Furthermore, little empirical support is offered for their postulates. In a recent evaluation of the H-M approach Salvatore[1] has shown not only is there little theoretical justification for a prediction of divergence of regional per capita incomes on the basis of their model, but empirical work indicates that for the case of Italy the market mechanism functions in a way that is beneficial rather than harmful to the development of the Italian South.

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[1] A simulation model incorporating many of the elements embodied in the H-M theory is set out by E. Olsen, "Regional Income Differences: A Simulation Approach," Regional Science Association Papers, XX, (Hague Conference, 1967), pp. 7-17.

An operational model which embodies many of the elements of the H-M approach has been set out by Williamson.[2] He argues that while market forces will on balance be disequilibrating during early stages of economic development they will tend to be equilibrating during more advanced stages of development. It is therefore postulated that an inverted U shaped pattern of regional inequality should be observed in most countries over time. Williamson's international cross section and time series analysis lends support to this theory.[3] On the basis of this support it would be reasonable to predict a convergence of regional per capita incomes in Canada over recent historical periods.

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[1] D. Salvatore, "The Operation of the Market Mechanism and Regional Inequality," Kyklos, XXV, (1972), pp. 518-536.

[2] Williamson, "Regional Inequality and the Process of National Development: A Description of Patterns."

[3] As pointed out in Chapter 1, the Canadian case is an exception to this predicted pattern.

3.5 CONCLUSIONS

From the foregoing summary it appears that although most of the relevant economic theory is inadequate in terms of explaining patterns of regional inequality the more complete models which take account of factor mobility and interregional trade generally suggest a pattern of convergence. In the static models this prediction is based on the assumption that factors move in search of their highest returns. Within the more realistic dynamic models this prediction of convergence not only depends on the direction of factor movements but also the speed of this adjustment and the extent of any associated backwash effects. Whether the conditions for convergence are met in this framework is an empirical question.

Further it is evident that not only do interregional factor movements play a key role in the theory of regional adjustment but that movements of one factor alone are sufficient for convergence. In the S-K model for example, it was indicated that migration from low to high wage regions is sufficient to produce convergence in the absense of interregional capital movements and even in the presence of perverse capital movements so long as they are not so large as to be overwhelming.

As already noted however, the theories summarized in this chapter are of limited usefulness in terms of explaining the patterns of Canadian regional adjustment. Many of the models view the adjustments as taking place in a static world where there is no natural growth in labor supply and no growth in labor demand. Clearly this is unsatisfactory given that the main purpose of this thesis is to explain the observed long-run pattern of adjustment over a period when there was both rapid economic growth and large regional differences in rates of growth and development.

A second shortcoming of these theories is that for the most part they incorporate only one form of interregional adjustment. For example, although trade theory stresses only commodity movements interregional factor movements are obviously also very important. Thirdly, much of the theory relating to adjustment through factor movements is partial equilibrium theory and as such does consider the simultaneous elements such as the "cause" and "effect" nature of interregional commodity and factor movements. For example, as emphasized by the supply dominated growth models, interregional labor movements are both a result of and cause of regional growth differences. Further, the mobility functions even for the more realistic models (such as the S-K model) are poorly specified. In most cases interregional labor movements are viewed as being guided strictly by earnings differentials although it is clear that other factors such as differences in employment opportunities are also important determinants.

Perhaps the most general criticism which can be made with respect to the above models is that they are much too simple and restrictive to adequately capture the important elements of regional adjustment. For example, assumptions of identical production equations, migration equations, and natural rates of increase are much too confining for the Canadian case. These types of simplifications however, are not generally imposed without reason; in most cases they are required to make the model manageable and to allow the model to be solved analytically. Moreover, most of the theories which are applicable to regional adjustment have been designed strictly for qualitative analysis and many of the simplifications are less restrictive with this type of analysis than with a quantitative analysis. Clearly, the latter type of analysis is essential for the problem at hand. For example, the analysis must provide information about the speed and pattern of change in regional wage inequality in addition to the direction of change in inequality.

In any case, the view taken here is that imposing excessively restrictive assumptions in the interest of obtaining unambiguous mathematical results is too great a cost. Thus an attempt is made in the next chapter to construct a model which is less restrictive in this sense and also incorporates more realistic interactions. These are outlined in the introduction to Chapter IV. Rather than deriving a mathematical solution to the model a numerical analysis is used to explore the characteristics of the model.

CHAPTER IV

A MODEL OF REGIONAL WAGE ADJUSTMENT

4.1 INTRODUCTION

In this chapter a dynamic two region model of regional wage adjustment is presented along with an analysis of its main characteristics. In designing the model an attempt was made to incorporate those elements which the literature suggests may be critical in the adjustment process (for example, interregional factor mobility). Further, an effort was made to avoid the major criticisms of the existing models applicable to regional adjustment. These were outlined above. In this regard the model: (i) is framed in dynamic terms, (ii) incorporates both interregional factor and commodity movements; interregional factor movements are taken account of explicitly and interregional commodity movements are taken account of implicitly, (iii) employs a more realistic labor mobility function; that is, interregional labor movements are related to factors additional to regional earnings differentials, and (iv) takes account of both the "cause" and "effect" nature of labor migration; that is, while labor migration is partly caused by regional earnings or income differentials, this migration, through its impact on regional labor supplies, also affects these differentials in the model.

It should also be pointed out that in the construction of the model, attention was paid to defining the equations in terms of variables for which Canadian regional data exist, or could be generated. This was an important consideration given the necessity of evaluating the model in terms of the Canadian experience.

4.2 THE GENERAL NATURE OF THE MODEL

Before setting out the model it is perhaps worthwhile to outline its general nature and establish its applicability to the Canadian case. The model views the nation as a system of regions in which each region is related to the aggregate of the remaining regions or the rest of the country (ROC). In addition, each region is assumed to be small relative to the nation so that while, for example, factor movements between the region and the ROC affect the economy of the individual region, they do not significantly affect the national economy.[1] This assumption is probably not unrealistic for Canadian regions, excluding Ontario and Quebec. For example, given that the Nova Scotia labor force (in 1971) amounted to only 3.1 per cent of the Canadian labor force (in 1971), it is not likely that even substantial out-migration from Nova Scotia would have a significant effect on the size of the labor force in the ROC.

The model to be presented is generally of the neoclassical type. As such it is basically supply driven, ignoring adjustments on the demand side. For example, it does not assume any of the adjustments via the balance of payments which regional income models[1] generally include and thus allows for the possibility that a balance of trade disequilibrium may be maintained over a long period of time. This however, may not be unrealistic in the Canadian case where such a disequilibrium may be maintained through Federal government interregional transfers.[2]

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[1] A model which incorporates pairwise linkages between all regions does not appear practicable at this time. For the most part the existing regional data are not sufficient to support such a large model.

Within a neoclassical framework, regional (real) wages are determined by the interaction of regional labor supply and regional labor demand or the marginal product of labor. In general then, the greater the increase in the marginal product of labor within a region relative to the increase in the labor supply, the greater will be the growth of wages within the region. Now it will be recalled that, over the post-war period at least, the rates of change in regional wage rates have been roughly the same.[1] At the same time there have existed large regional differences in unemployment rates. Now, while the literature would suggest that a neoclassical framework is the natural one to use for the problem investigated in this thesis, these two observations would seem to indicate the inappropriateness of the assumption of basically competitive markets inherent in the neoclassical framework. If this framework were appropriate lower rates of change in wages should be observed in the regions with high unemployment than in those with low unemployment.

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[1] See Chapter II, section 3.2.2.

[2] These include transfers in the form of unemployment insurance, transfers aimed at equalizing income tax bases, and those aimed at boosting the economies of lagging regions. For example, in 1960, the deficits on current account as a per cent of each province's total income for Nova Scotia, New Brunswick, Newfoundland, and Prince Edward Island were estimated to be 29.4, 19.1, 36.6 and 42 per cent respectively. These deficits were in turn financed by an excess of Federal expenditures over provincial tax collections to the extent of 80, 79, 72 and 86 per cent respectively. See, Kari Levitt, "A Macroeconomic Analysis of the Structure of the Economy of the Atlantic Provinces, 1960," a paper presented to the Meetings of the Canadian Economics Association, York University, June 6, 1969. Additional evidence of the role of such transfers in preventing balance of payments adjustments has been provided by Czamanski. See, Stan Czamanski, Regional Science Techniques in Practice, (Toronto: D.C. Heath and Company, 1972), pp. 128-129. His estimates indicate that for the period 1950 to 1965 as a whole, Nova Scotia's trade deficit has been financed by federal government transfer payments and exhaustive federal government spending in the province (part of which is related to the military establishment in Nova Scotia).

A fairly extensive analysis related to this apparent paradox has recently been undertaken by Thirsk[2] and Engerman.[3] Their analyses involve tests of four basic hypotheses of regional wage behavior: (i) a wage-emulation hypothesis, (ii) a wage-push hypothesis, (iii) a wage-pull hypothesis, and (iv) a structural hypothesis. Their findings lend considerable support to the structural hypothesis[4] which argues that regional wage behavior is determined primarily by regional supply and demand factors, and that observed differences in regional unemployment rates are due to regional differences in the efficiencies of labor markets. That is, while any changes in aggregate demand are diffused fairly evenly over regions, the resulting changes in labor demand result in different rates of absorption of the labor supply and hence in different unemployment rates. These inefficiencies are related to job mismatching (where the unemployed do not fit the requirements of unfilled vacancies), a lack of job information, or voluntary unemployment resulting when large sectoral wage differentials in the region produce high unemployment in the low-wage sectors.

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[1] See pp. 63-66 and Wayne Thirsk, Regional Dimensions of Inflation and Unemployment, a Research Report prepared for the Prices and Incomes Commission, (Ottawa: Information Canada, 1973), p. 20.

[2] Ibid.

[3] Stanley L. Engerman, "Regional Unemployment Differentials and Economic Policy," unpublished research paper, 1971.

[4] See Thirsk, Regional Dimensions of Inflation and Unemployment, p. 89. There it is shown that there are large regional variations in the "% vacancies - % unemployment" relationship.

On the basis of this explanation of the paradox indicated above then, the apparent objection to the use of a neoclassical framework is removed. In this study it is thus assumed that the regional wage behavior is largely determined by regional supply and demand factors. This assumption is further supported by work in this area by Rosenbluth.[1] He has concluded that there is evidence that the market price mechanism does in fact operate to allocate labor among industries, regions, and occupations in Canada.

4.3 THE MODEL

4.3.1 PRODUCTION TECHNOLOGY

It is assumed that the production process in region i can be described by a linear homogeneous production function exhibiting neutral technical progress.[1] That is,

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[1] Gideon Rosenbluth, "Wage Rates and the Allocation of Labor," Canadian Journal of Economics, I, (August, 1968), pp. 566-574.

$$4.3.1 \quad Q_{it} = \frac{Y_{it}}{P_{yit}} = A\, e^{rt}\, K_{it}^{\alpha}\, L_{it}^{1-\alpha};$$

where Y_{it} = gross product in region i in period t, P_{yit} = price deflator for gross product in region i in period t, Q_{it} = real gross product in region i in period t, A = a scalar, K_{it} = average real capital stock in region i in period t, L_{it} = average labor employment in region i in period t, α elasticity of output with respect to capital stock, $(1 - \alpha)$ = elasticity of output with respect to labor employment, r = rate of technical progress, and $\alpha > 0$, $r \geq 0$.

It is further assumed that the national production process can be described by the same type of production function and that there exists efficient interregional commodity trade so that regional price levels are equalized.[2] That is,

$$4.3.2 \quad Q_{nt} = \frac{Y_{nt}}{P_{ynt}} = A_n e^{r't}\, K_{nt}^{v}\, L_{nt}^{(1 - v)};$$

and

$$4.3.3 \quad P_{yit} = P_{ynt};$$

where all terms subscripted n refer to national variables.

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[1] In the form 4.3.1, technical progress is at the same time Harrod neutral, Hicks neutral and Solow netural.

[2] For Canada, there appears to be a very high correlation in annual price changes in the various components of the Consumer Price Index among all regions. This is the pattern which one would expect in a market economy with efficient trade. It should be noted however, that complete regional price equalization would require zero transportation costs, and that all goods be tradeable.

In this model, the rate of technical progress may be broadly defined to include not only the labor augmentation usually associated with such things as increases in the average level of education of the labor force, but also that associated with labor movements from the typically low productivity sectors (for example, agriculture) to the typically high productivity sectors (for example, manufacturing) and that associated with increased agglomeration of economic activity. Now in this context it is possible that interregional migration may affect the rate of agglomeration, and through its selective nature affect such factors as average levels of education and the age structure of the regional labor force. Changes in these would in turn affect the rate of technical progress. This possibility was investigated, and while the analysis was admittedly crude and based on some rather stringent assumptions it did not indicate a significant relationship between the rate of migration and the rate of technical progress.[1] Although the latter does

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[1] The basic approach used was as follows: If it is assumed that an identical Cobb-Douglas production function applies to all regions, then the growth of regional output is given by:

$$\frac{\dot{Q}}{Q} = r + \alpha \frac{\dot{K}}{K} + (1 - \alpha) \frac{\dot{L}}{L} \text{ ; where } \dot{Q} = \frac{dQ}{dt}, \text{ so } \frac{\dot{Q}}{Q} \text{ is the rate of}$$

growth of regional output. The other variables are similarly defined. Now given values for the growth of regional outputs, regional capital stocks, and regional employment, the rate of technical progress can be estimated by applying:

$$r = \frac{\dot{Q}}{Q} - [\alpha \frac{\dot{K}}{K} + (1 - \alpha) \frac{\dot{L}}{L}]$$

Using real personal income as a proxy for regional output, estimated regional capital stocks (see Appendix II), estimated regional employment, and assigning a value to α of .3, residuals r_{it} were calculated for each appear to be negatively related to the change in agricultural employment relative to total employment, no attempt was made to incorporate interregional-intersectoral labor movements into the model and thus the rate of technical progress was considered to be a parameter.

Within the model, natural resources (including land) are not considered as factors of production. Not only are there conflicting views in the literature on the role of natural resources in the growth of output,[1] but also there has been very little done on the topic of measuring these resources. While it is recognized that regional variations in the quality and quantity of natural resources probably have an effect on regional patterns of production and growth of per capita output, the overwhelming problems in theory and quantification dictated the exclusion of natural resources as an argument in the production function. This in turn necessitated the assumption that such resources

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of the ten provinces, for each of the five year periods 1951-56, 1956-61, 1961-66 and 1966-71. These forty residuals were then regressed on five-year-rates of interregional migration (M_{it}), the change in agricultural employment over the change in total provincial employment over each five-year period (CHAN) and, the change (over each five-year period) in the proportion of the provincial population which is classified as urban (CHU). The latter variable served as a proxy for the level of agglomeration. The estimated equation was: (t statistics are given in brackets).

$$\begin{array}{lllll} \rho = -4.54 & - .21\,\text{CHU} & - .69\,\text{CHAN} & + .08M & \qquad R^2 = .41 \\ \quad(-1.52) & (-.08) & (-1.90) & (.31) & \qquad \text{D.W.} = 1.86 \end{array}$$

[1] See for example, T.W. Shultz, "Connections Between Natural Resources and Economic Growth," Natural Resources and Economic Growth, J.J. Spengler (ed.), (Washington, D.C.: Resources for the Future, 1961). For an attempt to take account of the land factor in regional production see Horst Siebert, Regional Economic Growth: Theory and Policy (Scranton: International Textbook Company, 1969).

increase in all regions so as not to produce diminishing returns to labor and capital.

4.3.2 LABOR MARKETS

In the model it is assumed that an equilibrium where labor demand equals effective labor supply is maintained over the long-run in regional labor markets.[1] In addition, it is assumed that the long-run regional unemployment rate is determined by the efficiency of the region's labor markets, and that the latter is exogenously determined. Thus,

$$4.3.4 \quad L_{it} = L^{d}_{it} = (1 - U_t)\, L^{s}_{it};$$

where L_{it} = employment in region i in period t, L^{d}_{it} = labor demand in region i in period t, U_t = unemployment rate in region i in period t, L^{s}_{it} = labor supply in region i in period t, and $(0 < U_t < 1)$.

The regions labor supply is related to its population by,

$$4.3.5 \quad L^{s}_{it} = (p_t)(s_t)(P_{it});$$

where p_t is the region's participation rate, s_t is the proportion of the region's population which is classified as labor force source population (that is, non-institutionalized population 14 years of age and over), P_{it} = the population in region i at time t, and $(0 < p_t < 1)$, $(0 < s_t < 1)$.

---

[1] It is assumed here that wages always adjust so as to clear the market. The effective labor supply is the total labor supply less structural unemployment.

Equations 4.3.4 and 4.3.5 can be combined to yield,

4.3.6 $L_{it} = f_t(P_{it})$; where $f_{it} = (1 - U_t)\ (p_t)(s_t)$

The region's population at time t is given by the identity,

4.3.7 $P_{it} \equiv P_{it-1} + NI_{it-1} - M_{it-1}$;

where NI_{it-1} = the natural increase in region i's population in period t-1, and M_{it-1} = the net rate of migration from region i in period t-1.

Further,

4.3.8 $NI_{it-1} = n_{t-1}\ (P_{it-1})$;

where n_{t-1} = the natural rate of increase in the population in region i in period t-1, and $(0 < n_t < 1)$.

One of the most important equations in the model is that for interregional migration. For this reason it is worthwhile to outline the development of the particular migration equation employed.

As indicated in the last chapter there is considerable support for the notion that one of the most important determinants of interregional migration is the potential for improvement in income or earnings positions. In general, net out-migration from a region is hypothesized to be positively related to the excess of any income differentials between the region and other regions over the costs of migrating. Although such labor migration functions have generally been cast in a

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[1] U_t, p_t and s_t are exogenously determined.

linear form, a non-linear form such as 4.3.9 (graphed in Figure 4.3.1) is more plausible due to the implied restrictions of some asymtotically approached upper limit to interregional migration and a non-constant response of migration to income differentials.

4.3.9 $M_{it} = b_o + b_1 \, Ln(R_{it})$;

where M_{it} = out-migration from region i in period t, Ln = Niperian log, R_{it} = income or output per capita in the ROC relative to income or output per capita in region i in period t, and $b_o < 0$, $b_1 > 0$.

Alternatively, this can be written as,

4.3.10 $e^{M_{it}} = e^{b_o}(R_{it})^{b_1}$

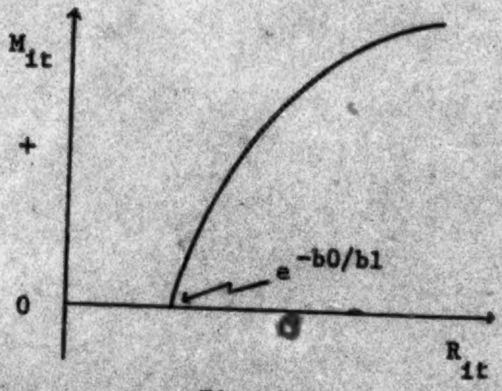

Fig. 4.3.1

It can be seen that according to this mobility function, migration from region i increases as the per capita income differential increases, but at a decreasing rate. It is reasonable to expect that because of capacity limitations in such things as housing markets and

BELL-FAST BOND
50% COTTON

transportation networks, there will be a decreased responsiveness of interregional migration to earnings differentials at high rates of migration. It may also be possible that given differing degrees of risk perception among potential migrants, as the rate of migration increases the proportion of migrants which have a high risk perception increases and hence the responsiveness of further migration to income differentials decreases.

In addition to stressing a variable elasticity of migration with respect to per capita income differentials,[1] this function rules out the case of an infinite elasticity over the range of R_{it}. As will be seen later, this has important implications for any model of wage adjustment.

In equation 4.3.9 the costs of interregional migration, stated in percentage terms, are given by $e^{-b0/b1}$.[2] That is, relative income per capita differentials must exceed $e^{-b0/b1}$ before out-migration takes place.

It is also important to note that by using relative output or income per capita as an explanatory variable, the effect on migration of regional variations in unemployment rates is implicitly taken into account.[1] For example, with a given regional wage differential, an increase in the unemployment rate in region i relative to the national unemployment rate will increase the relative per capita income differential and hence increase out-migration from the region.

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[1] This is given by: $\frac{\partial M_{it}}{\partial R_{it}} \cdot \frac{R_{it}}{M_{it}} = \frac{b_1}{b_o + b_1 \ln(R_{it})}$

[2] Alternatively, $\frac{-b_o}{b_1} = \ln(\text{Cost})$.

To this point it has been implicitly assumed that potential migrants react instantaneously to changes in relative regional income differentials. In reality, however, it is probably reasonable to expect that it will take several periods for such adjustments to be completed. This consideration leads to a specification of the migration function which includes lagged migration as an argument. It should be noted, however, that there may be additional reasons for including a lagged dependent variable in the migration function.[2] Greenwood,[3] for example, has included lagged migration as a proxy for the information flow associated with past migration. In general it is postulated that the greater are past rates of migration, the greater the awareness of potential migrants of existing differences in income and employment opportunities and hence, ceteris paribus, the greater the rate of current migration.

In order to take account of the case where there is only a partial adjustment of migration in any one period to income differentials, a specification patterned on Nerlove's Partial Adjustment Model[1] can be introduced. Postulating that desired migration from region i in period t is related to the relative per capita income differential in the same period gives,

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[1] An alternative method of taking this factor into account involves including relative unemployment rates along with relative wage differentials in the migration function. See p. 82.

[2] See T.P. Lianos, "The Migration Process and Time Lags, Journal of Regional Science, 12, (December, 1972), pp. 425-433.

[3] M.J. Greenwood, "Lagged Response in the Decision to Migrate, A Reply," Journal of Regional Science, 12, (August, 1972), pp. 311-324.

$$4.3.11 \quad M_{it}^{*} = b_{o} + b_{1}\mathrm{Ln}(R_{it});$$

where M_{it}^{*} = desired migration from region i in period t.

Further, assuming that the adjustment in the actual amount of migration is governed by the discrepancy between the desired amount of migration in period t and the actual amount of migration in the previous period gives,

$$4.3.12 \quad (M_{it} - M_{it-1}) = \Gamma (M_{it}^{*} - M_{it-1});$$

where Γ is the coefficient of partial adjustment, and $(o \leq \Gamma \leq 1)$ for stability.

Substituting 4.3.12 into 4.3.11 gives,

$$4.3.13 \quad M_{it} = \Gamma b_{o} + \Gamma b_{1}\mathrm{Ln}(R_{it}) + (1 - \Gamma)\ (M_{it-1});$$

which can be written as,

$$4.3.14 \quad M_{it} = \beta_{o} + \beta_{1}\mathrm{Ln}(R_{it}) + \beta_{2}(M_{it-1});$$

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[1] M. Nerlove, Distributed Lags and Demand Analysis, (Washington, D.C., U.S. Department of Agriculture, 1958).

where $\beta_o = \Gamma b_o < o$, $\beta_1 = \Gamma b_1 > o$, and $\beta_2 = (1-\Gamma) \geq o$.

In specifying a realistic migration function, consideration should be given to the effect of the growth of employment opportunities on the migration decision. Previous studies on migration have generally ignored this factor, yet it seems reasonable to expect that the greater the growth of employment opportunities in the nation relative to that in the region, the greater will be the long-run rate of out-migration from the region. This is related to the notion that a region with rapidly growing employment will tend to offer a wider selection of employment, a greater degree of upward mobility, and lower job search costs than a region with slow growth in employment. In this model such factors are taken account of through the inclusion of the rate of investment in the migration function.[1] For a low income region which typically experiences out-migration it is hypothesized that an increase in the rate of investment will, ceteris paribus, tend to decrease out-migration. For a high income region which typically experiences in-migration an increase in the rate of investment will, all other things equal, tend to increase the rate of in-migration. As will be shown later these considerations have important implications with respect to both the size of the regional wage differential and the nature of regional wage adjustment to changes in the level of exogenous investment.

The final migration equation which is to be employed in the model is given in 4.3.15 below.[1]

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[1] It should be noted that the use of investment as a proxy variable could introduce a problem of multicollinearity in the estimation of the migration function if changes in investment, through their effects on the marginal product of labor, are strongly related to changes in per capita income.

4.3.15 $$M_{it} = \beta_o + \beta_1 Ln(R_{it}) + \beta_2(M_{it-1}) + \beta_3(I_{it});$$

where I_{it} = rate of investment in region i in period t and, $\beta_o < 0$, $\beta_1 > 0$, $\beta_2 > 0$, $\beta_3 < 0$.

For the national economy it is also assumed that an equilibrium where labor demand equals effective labor supply[2] is maintained, and that the unemployment rate, the participation rate and the proportion of the total national population which is classified as the source population are all exogenously given. That is,

4.3.16 $$L_{nt} = f_{nt}(P_{nt});$$

where L_{nt} = level of national employment in period t; f_{nt} = $(1 - U_{nt})(p_{nt})(s_{nt})$; (P_{nt}) = the national population in period t, and $(0 < f_{nt} < 1)$.

It is further assumed that there is no net emigration or immigration from or to the national economy.[3] Thus,

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[1] Note that for a high income region which typically experiences in-migration, the equation will be $M_{it}' = \beta_o + \beta_1 Ln(R_{it}') + \beta_2(M_{it-1}') + \beta_3(I_{it})$; where M_{it}' = rate of in-migration to region in period t, R_{it}' = output per capita in region i relative to output per capita in the nation in period t and $\beta_3 > 0$. Further, in this case the identity 4.3.7 must be changed to $P_{it} \equiv P_{it-1} + NI_{it-1} + M_{it-1}$.

[2] Supra. p. 111.

[3] This assumption is less restrictive than first appears. Net immigration can be taken account of in the model if it is assumed that after landing in Canada, the interregional movements of these immigrants are guided by the same factors which determine other interregional migration.

4.3.17 $P_{nt} \equiv P_{nt-1} + NI_{nt-1}$;

where

4.3.18 $NI_{nt-1} = n_{nt-1} (P_{nt-1})$;

and where NI_{nt-1} = the national increase in the national population in period t-1, n_{nt-1} = the natural rate of increase in the national population, and $(0 < n_{nt} < 1)$.

4.3.3 CAPITAL

The capital stock in region i in period t is given by,

4.3.19 $K_{it} = K_{it-1}(1-d) + I_{it}$;

where K_{it} = average real capital stock in region i in period t, d = annual rate of depreciation of the capital stock, I_{it} = rate of real gross investment in region i in period t, and $(0 < d < 1)$.

In the neoclassical tradition, real gross regional investment must equal real gross regional saving in long-run equilibrium for a closed region. It is implicitly assumed that there is some mechanism to maintain this long-run equilibrium. If it is further assumed that the gross savings in the current period are a result of savings decisions made in the previous period, and that real gross regional saving is some constant proportion of real regional output, then,

4.3.20 $I_{it} = S_{it} = a_1(Q_{it-1})$;

where S_{it} = real gross saving in region i in period t, a_1 = the propensity to save out of gross regional output in the region, and $(0 < a_1 < 1)$.

In an open region however, regional investment need not equal saving in the region because investors may move financial capital into or out of the region depending on the return to capital in the region relative to that in the rest of the nation. If it is assumed that there are no costs involved in interregional movements of capital and that there is a one year gestation period involved for this additional capital in the new region, then regional investment will be given by,[1]

$$4.3.21 \quad I_{it} = S_{it} = a_0 + a_1(Q_{it-1}) + a_2(RK_{it-1});$$

or

$$4.3.22 \quad I_{it} = S_{it} = a_1(Q_{it-1}) + a_2(RK_{it-1} - 1);$$

where $a_0 = -a_2$, RK_{it} = the return to capital in region i in period t relative to the return to capital in the rest of the nation in period t, and $a_1 > 0$, $a_2 > 0$. This capital formation equation assumes instantaneous adjustment of regional investment to desired levels of regional investment. In order to take account of interregional information flows lagged regional investment can be included as an argument in the equation. That is, using an argument similar to that for the inclusion of lagged migration in the migration equation, a relatively high rate of regional investment may imply a large inflow of capital to the region which increases interregional information flows regarding relative investment opportunities and risks. The equation which incorporates a lagged adjustment is given in 4.3.21 below.

$$4.3.21 \quad I_{it} = S_{it} = a_1(Q_{it-1}) + a_2(RK_{it-1} - 1) + a_3(I_{it-1});$$

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[1] Note that "-1" in the last term in 4.3.21 and "a_0" in 4.3.21 imply that capital flows to region i according to the amount by which the relative return (RK_i) exceeds 1.

where $a_1 > 0$ and $(0 < a_3 < 1)$ for stability.

For the national economy, the capital stock in period t is given by,

$$4.3.22 \quad K_{nt} = K_{nt-1}(1-d) + I_{nt};$$

where K_{nt} = real national capital stock, d = rate of depreciation of the capital stock, I_{nt} = real gross national investment in period t and $(0 < d < 1)$.

Further, it is assumed that the national rate of gross investment is determined by the national gross saving according to equation 4.3.23.

$$4.3.23 \quad I_{nt} = S_{nt} = c_1(Q_{nt-1});$$

where S_{nt} = gross national saving in period t, c_1 is the propensity to save out of gross output, and $(0 < c_1 < 1)$.

4.3.4 FACTOR PRICES

Under the assumption of competitive factor markets, factors are paid according to their marginal product.[1] Thus, the regional and national wage rates in period t are given by 4.3.24 and 4.3.25 respectively. It should be noted that because of the full employment assumption embodied in the model there must be instantaneous wage adjustment. That is, while the model does allow for structural unemployment no allowance is made for unemployment of the demand

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[1] The regional marginal product of labor given the Cobb-Douglas production function in 4.3.1 is:

$$\frac{\partial Q_{it}}{\partial L_{it}} = (1-\alpha)A\, e^{rt} K_{it}^{\alpha}\, L_{it}^{1-\alpha} = (1-\alpha)\frac{Q_{it}}{L_{it}}\,.$$

The national marginal product of labor is similarly defined.

deficient variety.

$$4.3.24 \quad w_{it} = (1-\alpha)\,\frac{Q_{it}}{L_{it}};$$

where w_{it} = real wage rate in region i in period t.

$$4.3.25 \quad w_{nt} = (1-v)\,\frac{Q_{nt}}{L_{nt}};$$

where w_{nt} = real wage rate in the nation in period t.

Similarly, the returns to capital in the region and the nation are determined by the respective marginal products of capital and are given in 4.3.26 and 4.3.27 below.

$$4.3.26 \quad rk_{it} = \alpha\left(\frac{Q_{it}}{K_{it}}\right);$$

where rk_{it} = the regional return to capital in period t.

$$4.3.27 \quad rk_{nt} = v\left(\frac{Q_{nt}}{K_{nt}}\right);$$

where rk_{nt} = the national return to capital in period t.

The relative return to capital in region i in period t (RK_{it}) is defined as,

$$4.3.28 \quad RK_{it} = \frac{rk_{it}}{rk_{nt}}.$$

4.4 BASIC CHARACTERISTICS OF THE MODEL

This section is devoted to exploring the dynamic characteristics of the model set out above. Particular attention is focused on the following questions: (i) What are the primary factors in the growth of regional wage rates? (ii) Given any initial wage differential, what time pattern of adjustment in relative regional wage rates does the model produce? That is, does it produce wage convergence, and if so, is it slow or rapid? (iii) Is the model capable of producing a long-run equilibrium wage differential, and if so what are the critical determinants of the size of this differential? (v) Finally, if the model is capable of generating a long-run equilibrium wage differential, what are its stability properties? For example, under what conditions will such an equilibrium trend be maintained in spite of significant shocks (in the form of increased or decreased exogenous investment) to the regional economy?

In order to answer these questions the model must first be solved. That is, the wage rate differential must be expressed solely as a function of the parameters of the model and exogenous variables. Further, a specific solution in the form of a solution to a set of difference equations[1] must be found since it is only through a detailed examination of such a solution that answers to questions such as (ii) and (iii) above can be found. Due to the many lagged variables, the stock-flow relationships, and the non-linearities embodied in the model however, such a solution appears extremely difficult, if not impossible, to find.

In dealing with this problem, two possible routes can be taken. The first involves a major simplification of the theoretical structure of the model so that a solution can be easily found. This however, would involve significant modifications to the key adjustment characteristics of the model and thus would probably defeat the purpose of constructing a realistic model which can be related to the Canadian experience. The second route involves exploration of the dynamic characteristics of the model with the aid of numerical analysis. With this approach, the model is simulated over time for various parameter values and initial condition combinations, and then the time paths of the regional wage differential are compared. Although this approach has less generality than the first,[1] it avoids retreating to a simpler framework with less interesting characterizations of regional wage inequality.

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[1] That is, the wage differential at time t must be expressed as some function of time alone.

In the analysis of the model presented in the following sections, the following approach is taken. First, some slight modifications are made to the model so that expressions for the growth of regional wage rates and the relation between the growth of a region's wage rate and the level of its wage rate can be found. These expressions will throw some light on questions (i) and (ii) above. It should be noted however that these modifications are not sufficient to allow the solution required to answer the remaining questions to be found. In order to deal with these questions, a numerical analysis of the model is undertaken. This is explained in more detail in section 4.5.

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[1] In the sense that it is that of induction from specific results rather than that of deduction from general assumptions.

4.4.1 BASIC GROWTH CHARACTERISTICS OF A MODIFIED VERSION OF THE MODEL

A modified version of the model is presented in equations 4.4.1 to 4.4.17 below. These modifications, which are detailed below, were required in order to determine the basic growth characteristics of regional wage rates in the model, but should not significantly affect the overall conclusions.

4.4.1 $Q = e^{rt}K^{\alpha}L^{1-\alpha}$

4.4.2 $Q_n = e^{rt}K_n^{\alpha}L_n^{1-\alpha}$

4.4.3 $w = (1-\alpha)\frac{Q}{L}$

4.4.4 $w_n = (1-\alpha)\frac{Q_n}{L_n}$

4.4.5 $rk = \alpha\frac{Q}{K}$

4.4.6 $rk_n = \alpha\frac{Q_n}{K_n}$

4.4.7 $RK = \frac{rk}{rk_n}$

4.4.8 $\dot{K} = I - K(d)$

4.4.9 $\dot{K}_n = I_n - K_n(d)$

4.4.10 $I = S = a_1(Q) + a_2(RK-1)(K)$

4.4.11 $I_n = S_n = c_1(Q_n)$

4.4.12 $L = f(P)$

4.4.13 $L_n = f_n(P_n)$

4.4.14 $\frac{\dot{P}}{P} = n-m$

4.4.15 $\frac{\dot{P}_n}{P_n} = n_n$

4.4.16 $m = b_0 + b_1R + b_2(\frac{I}{K})$

4.4.17 $R = (\frac{Q_n}{P_n})/(\frac{Q}{P})$

The variables and parameters in the model are defined in exactly the same way as in section 4.3 above.[1] The equations are based on the respective equations of the basic model set out in the previous section. The i subscripts have been dropped for notational convenience.

The modifications to the basic model include:

(i) the change from a discrete form to a continuous form. This required that all equations be defined in terms of current variables (note that the t subscripts have been dropped) and that lagged investment and lagged migration be dropped as arguments in the capital formation and migration equations respectively.

(ii) the multiplication of the differential return to capital variable in the capital formation equation by K. This was necessary to find a solution to the model.

(iii) a change in the specification of the migration function so that the rate of migration (expressed as the number per 1000 population per year rather than, as previously defined, the number per year) is inversely related to the rate of investment relative to the capital stock, rather than simply the rate of investment. This change was also necessary in order to solve the model.

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[1] The notation such as $\dot{K}$ refers to the first derivative of the variable with respect to time. That is, $\dot{K} = dK/dt$.

(iv) the addition of the assumption of identical production functions for the region and the nation.

Given these changes, the model can be solved in the following way. Taking the natural log of 4.4.1 and differentiating with respect to time gives,

$$4.4.18 \quad \frac{\dot{Q}}{Q} = r + \alpha\frac{\dot{K}}{K} + (1-\alpha)\frac{\dot{L}}{L} \; ;$$

where $\dot{Q} = \frac{d_Q}{d_t}$ and the other variables are similarly defined.

Performing the same operation on 4.4.3 gives,

$$4.4.19 \quad w^* = \frac{\dot{w}}{w} = \frac{\dot{Q}}{Q} - \frac{\dot{L}}{L} \; ;$$

where w^* is the percentage rate of growth of the regional wage.

Substituting 4.4.18 into 4.4.19 gives,

$$4.4.20 \quad w^* = r + \alpha\frac{\dot{K}}{K} - \alpha\frac{\dot{L}}{L} \, .$$

That is, the growth of the regional wage rate is positively related to the rate of technical progress and the rate of growth of the capital stock and inversely related to the growth of labor. The growth rates of the latter two factors are determined as follows.

Taking 4.4.8, dividing by K and substituting in 4.4.5, 4.4.6, 4.4.7, and 4.4.10 gives,

$$4.4.21 \quad \frac{\dot{K}}{K} = a_1\left(\frac{Q}{K}\right) + a_2\left[\left(\frac{Q}{K} \cdot \frac{K_n}{Q_n}\right) - 1\right] - d$$

Now from 4.4.1,

$$4.4.22 \quad \frac{Q}{K} = e^{rt}\left(\frac{K}{L}\right)^{\alpha-1};$$

and

$$4.4.23 \quad \frac{K}{L} = \left(\frac{Q}{L}\right)^{\frac{1}{\alpha}} \cdot e^{\frac{-rt}{\alpha}}$$

Substituting 4.4.23 into 4.4.22 gives,

$$4.4.24 \quad \frac{Q}{K} = \left(\frac{Q}{L}\right)^{\frac{\alpha-1}{\alpha}} \cdot e^{\frac{rt}{\alpha}},$$

and from 4.4.3,

$$4.4.25 \quad \frac{Q}{K} = \left(\frac{w_n}{1-\alpha}\right)^{\frac{\alpha-1}{\alpha}} \cdot e^{\frac{rt}{\alpha}}$$

The expression for $\frac{Q_n}{K_n}$ is derived in a similar fashion and is given by,

$$4.4.26 \quad \frac{Q_n}{K_n} = \left(\frac{w_n}{1-\alpha}\right)^{\frac{\alpha-1}{\alpha}} \cdot e^{\frac{rt}{\alpha}}$$

Now substituting 4.4.25 and 4.4.26 back into 4.4.21, and simplifying yields,

$$4.4.27 \quad \frac{\dot{K}}{K} = a_1\left(\frac{w}{1-\alpha}\right)^{\frac{\alpha-1}{\alpha}} \cdot e^{\frac{rt}{\alpha}} + a_2\left(\frac{w}{w_n}\right)^{\frac{\alpha-1}{\alpha}} - a_2 - d$$

On the assumption that the proportion of the regional population which is employed (f) is constant, 4.4.12 yields,

$$4.4.28 \quad \frac{\dot{L}}{L} = \frac{\dot{P}}{P};$$

and

$$4.4.29 \quad \frac{Q}{P} = f\left(\frac{w}{1-\alpha}\right)$$

when combined with 4.4.3.

For the national economy,

$$4.4.30 \quad \frac{Q_n}{P_n} = f_n\left(\frac{w_n}{1-\alpha}\right)$$

Further, substituting 4.4.8, 4.4.27, 4.4.17, 4.4.29 and 4.4.30 into 4.4.16 and then substituting this into 4.4.14 and combining with 4.4.28 yields,

$$4.4.31 \quad \frac{\dot{L}}{L} = n - b_0 - b_1 \cdot \frac{f_n}{f}\left(\frac{w_n}{w}\right) - b_2 \cdot a_1\left(\frac{w}{1-\alpha}\right)^{\frac{\alpha-1}{\alpha}} \cdot e^{\frac{rt}{\alpha}} - b_2 \cdot a_2\left(\frac{w}{w_n}\right)^{\frac{\alpha-1}{\alpha}} + b_2 \cdot a_2$$

Finally, 4.4.27 and 4.4.31 can be substituted into 4.4.20 to get the expression for the growth rate of the regional wage rate. That is,

$$4.4.32 \quad w^* = \frac{\dot{w}}{w} = r + [\alpha \cdot a_1(1+b_2)]\left[\left(\frac{w}{1-\alpha}\right)^{\frac{\alpha-1}{\alpha}} \cdot e^{\frac{rt}{\alpha}}\right] - \alpha \cdot a_2 + \alpha \cdot b_1\left(\frac{f_n \cdot w_n}{f \cdot w}\right) + [\alpha \cdot a_2(1+b_2)]\left[\left(\frac{w}{w_n}\right)^{\frac{\alpha-1}{\alpha}}\right] + \alpha \cdot b_0 - \alpha \cdot d - \alpha \cdot n - \alpha \cdot b_2 \cdot a_2 \,.$$

Now it will be recalled that the a priori restrictions on the parameters are: $r > 0$, $0 < \alpha < 1$, $0 < a_1 < 1$, $a_2 > 0$, $b_0 < 0$, $b_1 > 0$, $b_2 < 0$, $0 < d < 1$, $n \geq 0$, and, $w \leq w_n$. Given these, several characteristics of the growth rates of regional wage rates can be noted. First, the growth rate is, as one would expect, positively related to the rate of technical progress and negatively related to the rate of depreciation of the capital stock and the natural rate of increase of the regional population. Second, the smaller is b_0, the slower the rate of growth of wage rates. This result is related to the fact that a decrease in b_0 represents an increase in the costs associated with out-migration and the consequent reduction in the amount of out-migration means, ceteris paribus, a more rapid rate of growth in the regional labor force. The latter in turn tends to depress the growth of the wage rate. For similar reasons, an increase in the response of the rate of migration to capita income differentials (that is, an increase in parameter b_1) will have a favorable effect on the growth of the regional wage rate. Finally, it should be noted that so long as the coefficient b_2, which represents the response of the rate of migration to rate of growth in the gross regional capital stock, falls in the interval $(-1 < b_2 < 0)$ there must be a positive relationship between the growth of wages in the region and the size of the wage differential.

Of more immediate interest, however, is the relationship between the level of the regional wage rate and its growth rate. In particular, if $\frac{d_{w}^{*}}{d_{w}} < 0$, then one would expect a convergence of regional wage rates. The expression for $\frac{d_w^*}{d_w}$ is given in 4.4.33 below.

$$4.4.33 \quad \frac{d_w^*}{d_w} = [-a_1(1+b_2)]\,[(\frac{w}{1-\alpha})^{\frac{-1}{\alpha}} \cdot e^{\frac{rt}{\alpha}}] + [-\alpha b_1 \cdot \frac{f_n}{f}(\frac{w_n}{w^2})]$$

$$+ [-(1-\alpha)a_2(1+b_2)]\,[(\frac{w}{w_n})^{\frac{-1}{\alpha}} \cdot (\frac{1}{w_n})]$$

Now recalling the a priori restrictions on the parameters it can be seen that $\frac{d_w^*}{d_w}$ will be less than zero so long as $-1 \leq b_2 \leq 0$.[1] Thus under this condition the model does produce a convergence of wage rates. If however, the rate of migration is highly responsive to the growth of the gross regional capital stock such that $b_2 < -1$, then convergence is no longer assured since only the third term in 4.4.33 will be negative. In fact, given a large enough value for b_2, regional wage rates will diverge. This would be the case where an increase in the growth of a region's capital stock resulting from a higher return in the region relative to that in the nation reduces the rate of out-migration (and hence increases the growth of regional labor) to such an extent that the capital-labor ratio falls.

Although this analysis shows that the direction of regional wage adjustment produced by the model depends critically on the response of migration to changes in the region's capital stock, it yields no information with respect to either the actual time pattern of wage adjustment, or the equilibrium wage differential (if one exists) produced by the model. Clearly, these latter considerations are of extreme importance in terms of relating the model to the trends in Canadian regional wage inequality. It is to these issues that attention is now focused.

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[1] Under these conditions, $\frac{d_w^*}{d_w} = [(-)][(+)] + [(-)][(+)] + [(-)] < 0$.

4.5 NUMERICAL ANALYSIS OF THE MODEL

4.5.1 THE GENERAL NATURE OF THE EXPERIMENTS

In order to gain information with respect to the nature of the time patterns of adjustment produced by the model the technique of numerical analysis was employed. Briefly, this involved programming a computer for the complete model (summarized in equations 4.5.1-4.5.2 below), and then running the model over time on the computer to generate the simulated time paths for the relative wage differentials associated with various initial conditions and various assigned values for the parameters of the model. The results of these experiments were then evaluated to determine the dynamic characteristics of the model.[1]

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[1] It must be stressed that this analysis is not designed for the purpose of simulating actual wage adjustment in various Canadian regions. Rather, it is designed solely for the purpose of determining the dynamic characteristics of the mathematical model of wage adjustment. As such, the nature of the analysis should not be confused with that involved in the simulation of econometric models. With respect to the latter, see Thomas N. Naylor, Computer Simulation Experiments With Models of Economic Systems, (New York; John Wiley & Sons Inc., 1971).

EQUATIONS OF THE MODEL

4.5.1 $Q_{it} = \frac{Y_{it}}{P_{yit}} = A\ e^{rt} K_{it}^{\alpha}\ L_{it}^{\ 1-\alpha}$

4.5.2 $Q_{nt} = \frac{Y_{nt}}{P_{ynt}} = A_n\ e^{r't} K_{nt}^{v}\ L_{nt}^{\ 1-v}$

4.5.3 $P_{yit} = P_{ynt}$

4.5.4 $w_{it} = (1-\alpha)\frac{Q_{it}}{L_{it}}$

4.5.5 $w_{nt} = (1-v)\frac{Q_{nt}}{L_{nt}}$

4.5.6 $rk_{it} = \alpha(\frac{Q_{it}}{K_{it}})$

4.5.7 $rk_{nt} = v(\frac{Q_{nt}}{K_{nt}})$

4.5.8 $RK_{it} = \frac{rk_{it}}{rk_{nt}}$

4.5.9 $K_{it} = K_{it-1}(1-d) + I_{it}$

4.5.10 $K_{nt} = K_{nt-1}(1-d) + I_{nt}$

4.5.11 $I_{it} = S_{it} = a_1(Q_{it-1}) + a_2(RK_{it-1} - 1) + a_3(I_{it-1})$

4.5.12 $I_{nt} = S_{it} = c_1(Q_{nt-1})$

4.5.13 $P_{it} = P_{it-1} + NI_{it-1} - M_{it-1}$

4.5.14 $P_{it} = P_{it-1} + NI_{it-1} + M'_{it-1}$

4.5.15 $P_{nt} = P_{nt-1} + NI_{nt-1}$

4.5.16 $NI_{t-1} = n_{t-1}(P_{it-1})$

4.5.17 $NI_{nt-1} = n_{nt-1}(P_{nt-1})$

4.5.18 $M_{it} = \beta_0 + \beta_1 \mathrm{Ln}(R_{it}) + \beta_2(M_{it-1}) + \beta_3(I_{it})$

4.5.19 $M'_{it} = \beta_0 + \beta_1 \mathrm{Ln}(R'_{it}) + \beta_2(M'_{it-1}) + \beta_3(I_{it})$

4.5.20 $R_{it} = (\frac{Q_{nt}}{P_{nt}}) \ / \ (\frac{Q_{it}}{P_{it}})$

4.5.21 $R'_{it} = (\frac{Q_{it}}{P_{it}}) \ / \ (\frac{Q_{nt}}{P_{nt}})$

4.5.22 $L_{it} = (f)(P_{it})$

4.5.23 $L_{nt} = (f_n)(P_{nt})$

Before outlining the various experiments performed and the results of each, several comments relating to the general conditions for the experiments should be made. First, in the experiments (excepting Experiment Set I, the Static Case), it was assumed that the national propensity to save was such that the national capital stock grows at a constant rate (equal to 4 per cent per year), and that the national labor supply also grows at a constant rate. Hence, the rate of growth of national output as determined by the production function (eqtn. 4.5.1) was also constant. Thus, no account was taken of the possible effects which the business cycles normally experienced in an economy might have on regional wage adjustment. To the extent that such cycles follow a regular pattern, they should have little effect on the long-run pattern of wage inequality.

Further, the initial values used for the national economy were actual 1950 Canadian values. This was done as a matter of convenience and to insure that the variables and parameters were of reasonable orders of magnitude. The actual values assigned for the national economy are summarized in Table 4.5.1.

TABLE 4.5.1

INITIAL CONDITIONS AND ASSIGNED PARAMETER VALUES
FOR THE NATIONAL ECONOMY.

Q_{no} = real 1950 GNP (in millions of 1961$) = 24,451

P_{no} = 1950 Canadian Population (in thousands) = 13,712

K_{no} = real Capital Stock (in millions of 1961\$)[1] = 49,273

f_{no} = 1950 Canadian Population (in thousands) divided by 1950 Canadian Employment (in thousands) = .363

$\mathrm{Ln}(A_n)$ = scalar for national production function[2] = -.1

d = annual rate of depreciation of national capital stock[3] = .08

n_n = natural annual rate of increase of national population[4] = .02

$\dot{k}/k$ = annual rate of growth of national capital stock[4] = .04

v = elasticity of national output with respect to capital[4] = .3

r = annual rate of productivity growth[4] = .02

A second point relating to the assumed general conditions is that in all experiments, both fn and f (the proportion of the population which is employed in the nation and the region respectively) were held constant over time. This was done so that the results for long-run wage adjustment would not be confused by short-run variations in such things as participation and unemployment rates. In this regard it should also be noted that the implied constant relationship between fn and f appears reasonable in terms of relating the results of the experiments to the Canadian case.[1]

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[1] See Appendix II for the derivation of the capital stock estimate. The data for the other variables is conveniently summarized in Economic Review, (Ottawa: Information Canada, April 1973).

[2] This value was derived by substituting assigned values for parameters and variables into the national production function (eqtn. 4.5.2).

[3] See Appendix II.

[4] These values are approximations of actual Canadian values. Also note that the natural rate of increase is given in percentage terms rather than in number per thousand base population.

In designing the various experiments, particular attention was focused on determining the adjustment paths under various degrees of factor mobility since it was felt intuitively that this factor would be important in the regional wage adjustment process. In assigning values for the parameters which represent the degree of factor mobility, (that is, parameters in the migration and capital formation equations) an attempt was made in most of the experiments to keep the values within reasonable ranges. That is, the various parameters were set so that, for example, the rate of interregional migration would not be unreasonable in relation to historical rates for regions of a size approximate to that of the assumed region.

Finally, it should be noted that while most of the experiments were done for both a slow-growth-region case (that is, where the region typically has out-migration) and a rapid-growth-region case (that is, where the region typically has in-migration), only the results for the former case are reported in detail. This was done in order to prevent confusion and allow easy comparisons among the experiments. The general results for the rapid-growth-region case are summarized in the text.

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[1] See pp. 60-63. There it is shown that the degree of regional inequality in the employment base (that is, f) has remained relatively constant over time.

4.5.2 EXPERIMENT SET I (STATIC CASE)

The general purpose of this set of experiments was to determine the adjustment properties of the model under static conditions with a view to comparing the results with other static models of regional wage adjustment[1] and of providing a benchmark in the evaluation of the model's dynamic properties (to be determined below).

In this set of experiments, the national population, capital stock and output were held at their initial levels.[2] Further, identical production functions and employment bases were assumed for the region and the nation.

The initial values for the regional population and capital stock were chosen quite arbitrarily. It was assumed that there is no natural growth in the labor force ($n = 0$), no endogenous savings ($a_1 = 0$), and no depreciation ($d = 0$) so that changes in its capital stock or labor force can only come about through a reallocation of existing supplies of capital and labor. Also, it was assumed that there is complete adjustment with respect to both migration and investment so the parameters for lagged migration and lagged investment were assigned values of zero. These general conditions, common to all of the experiments in Set I, along with the conditions specific to each experiment are summarized in Table 4.5.2.

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[1] See chapter 3.

[2] That is, $I_n = 0$, $n_n = 0$, and time was held constant.

TABLE 4.5.2

CONDITIONS FOR EXPERIMENT SET I

GENERAL CONDITIONS:

1. P_o = regional population in initial period (in thousands) = 550
2. K_o = regional capital stock in initial period (in millions of 1961$) = 1000
3. f = regional employment base = fn = .363
4. n = regional natural rate of increase = n_n = 0
5. d = depreciation rate for regional capital stock = 0
6. Ln(A) = scalar for regional production function = $Ln(A_n)$ = -.1
7. r = rate of productivity growth = .02
8. α = elasticity of regional output with respect to capital stock = v = .3
9. t = time = 50

SPECIFIC CONDITIONS:

[Note: $M_{it} = \beta_0 + \beta_1 Ln(R_{it}) + \beta_2 M_{it-1} + \beta_3 I_{it}$; and $I_{it} = S_{it} = a_1 Q_{it-1} + a_2(RK_{it-1} - 1) + a_3 I_{it-1}$]

PARAMETER VALUES

EXPT	β_o	β_1	β_2	β_3	a_1	a_2	a_3
1a	-8	400	0	0	0	0	0
1b	-8	400	0	0	0	200	0
1c	-8	400	0	0	0	5000	0

The assigned values for the parameters in the migration function imply a mobility constraint (representing migration costs) of 2 per cent[1] and an elasticity of migration with respect to the per capita income differential (at the initial level of inequality)[2] equal to 5.9.

The time paths for the relative regional wage differential generated by the model under the above conditions are presented in Figure 4.5.1. There it can be seen that in EXPT 1a, the case where labor is mobile but capital is not, starting from a regional wage which is 82.5 per cent of the national wage an equilibrium relative wage of 98 per cent is reached in 11 years. This equilibrium wage differential, which is exactly equal to the labor mobility constraint, is the same as that predicted by most static models with immobile capital. This particular result is due to the fact that so long as the national wage rate exceeds the regional wage rate by more than 2 per cent, and hence national per capita income exceeds regional per capita income by more than 2 per cent, there is out-migration from the region thus raising the regional capital-labor ratio and therefore the regional wage rate. When the wage rises to within 2 per cent of the national wage out-migration stops and the wage rate stabilizes. Finally, it should be noted that in the case of a rapid-growth-region where the initial regional wage exceeds the national wage, the final equilibrium for this case will be where the regional wage is 102

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[1] That is, $e^{-\frac{(-8)}{400}} = 1.02$

[2] The initial conditions imply a regional (real) wage rate of $2839 which is 82.5% of the national (real) wage rate ($3440).

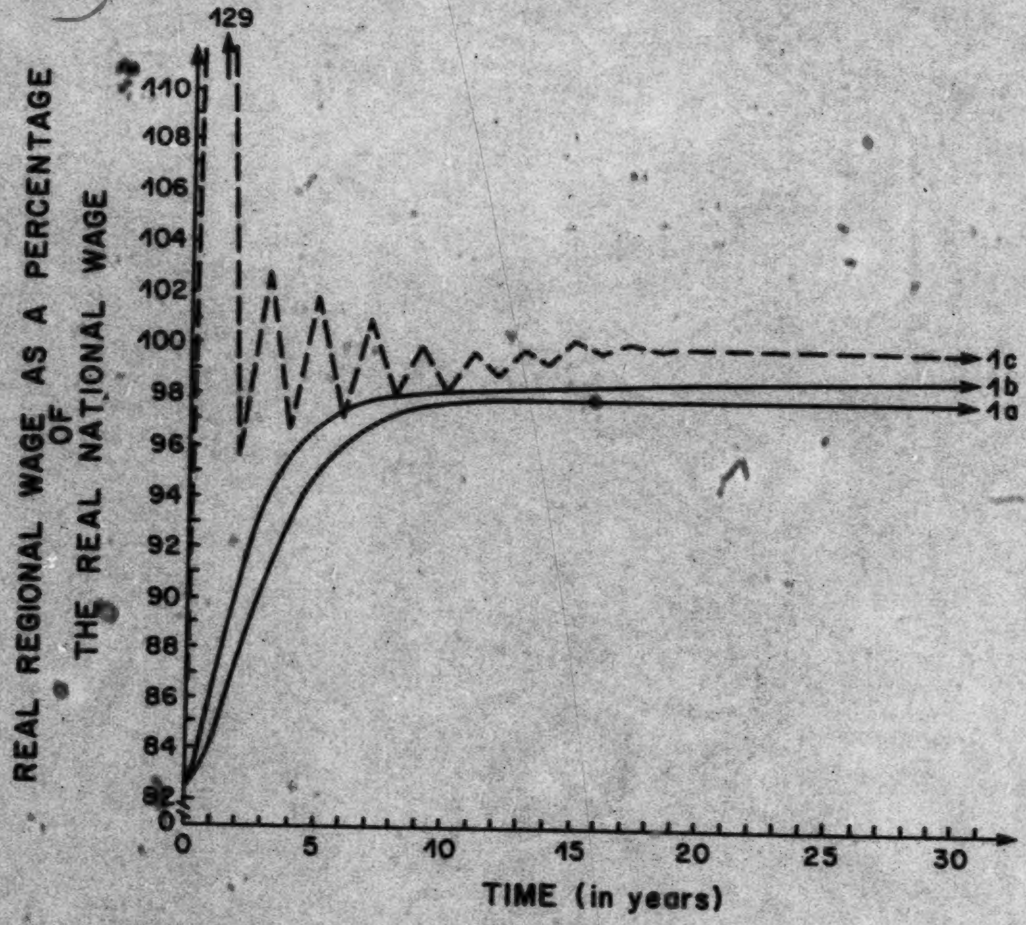

FIGURE 4.5.1

RELATIVE REGIONAL WAGE TIME PATHS FOR EXPERIMENT SET I per cent of the national wage.

In EXPT 1b there is labor mobility and perfect or complete capital mobility; that is to say there are no costs incurred in interregional capital movements. It is interesting to note that in this case there is a rapid convergence (relative to that in 1a) to a relative wage differential of 98 per cent and then very slow convergence beyond this point. This is explained by the fact that after the 98 per cent level is reached out-migration stops and thus all remaining adjustments must be through capital movements. Moreover, since the output-capital ratio is typically much smaller than the output-labor ratio, a given percentage increase in the capital stock produces a smaller increase in the marginal product of labor than the same percentage decrease in employment, and hence the rate of wage convergence beyond this point is much lower.

It is interesting to note that in this case an equilibrium is eventually reached (after about 100 periods) where the regional wage is exactly equal to the national wage. Thus it can be seen that complete regional wage equalization requires only one factor to be perfectly mobile.

EXPT 1c demonstrates the adjustment pattern where there is both labor and capital mobility and where capital movements are highly sensitive to return differentials among regions. In this case, while the regional wage does converge to the national wage, the adjustment process is not smooth. Rather, it involves damped oscillations around a trend approaching the 100 per cent level. These oscillations are a result of the very large interregional movements of capital. For example, in the initial period where the regional wage is below the national wage and the return to capital in the region is above that for the nation, there is an inflow of capital to the region which is very large relative to the initial capital stock. This produces a situation in the second period where the return to capital in the region is below that for the nation (and where the regional wage is above the national wage) and hence where there must now be a large capital outflow from the region. In any case, it does appear that even with interregional capital and labor flows which are highly sensitive to return differentials [1] the adjustment mechanism embodied in the model possesses a high degree of stability.

4.5.3 EXPERIMENT SET II (DYNAMIC CASE)

This set of experiments was designed to investigate the time patterns of regional wage inequality generated by the model under conditions where both the regional and national economies are growing, and to relate these time patterns to the parameters in the mobility functions. With respect to the general pattern of wage inequality, it was felt intuitively that when both economies were growing the equilibrium wage differential (if one exists) would not necessarily be equal to that produced by the static version of the model. That is, it would not necessarily be equal to the costs associated with interregional factor movements. In particular it was felt that for a slow-growth-region case for example, the equilibrium wage differential (if such exists) would be larger than that produced by static models of interregional wage adjustment. This was related to the idea that in a dynamic system there would exist centrifugal type forces in addition to the resistances associated with mobility constraints which would prevent the attainment of a wage differential equal to mobility costs. One can view the national economy as a large block of matter and the regional economy as a much smaller block of matter, where both blocks rest in a frictionless plain and are connected by elastic bands with elasticities representing the response parameters in the mobility function. When the national block is stationary the regional block should come to rest at a distance from the national block which is representative of the interregional mobility costs. If however, the national block is moving forward at a constant rate of speed the regional block should, given the same elasticities of the connecting forces, tend to trail at a distance greater than that representing the costs associated with interregional factor movements. Using this interpretation then, one would expect the size of any dynamic equilibrium wage differential to be positively related to the size of the response of interregional factor movements to interregional earnings differentials.

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[1] The initial return to capital in the region relative to that in the nation was (24.3/14.9) = 1.63. In the first period then, there was inflow of capital equal to 3150 or better than 3 times the initial capital stock.

With this in mind EXPTs 2a, 2b and 2c (outlined below) were designed to evaluate the effects which changes in the response of migration to per capita income differentials have on the pattern of wage inequality, while EXPT 2d was designed to evaluate the effects on this pattern of including investment in the migration function. EXPTs 2b, 2e and 2f were designed to determine the effect which changes in the response of capital flows to return differentials have on long-run wage inequality.

As in EXPT Set I, attention was centered on wage adjustment for a slow-growth-region in which the production function, employment base and natural rate of increase are assumed to be identical to those for the nation. Further, since the inclusion of the lagged dependent variables in the capital formation and migration functions may have confused the results, and since it was felt that they would have little bearing on the long-run pattern of wage inequality, the coefficients for these variables (β_2 and a_3) were assigned zero values. In addition it should be noted that while the different parameter values in the migration imply different elasticities with respect to income differentials, in every case they imply a mobility constraint (representing migration costs) equal to 2 per cent.[1] The conditions for EXPT Set II are set out in Table 4.5.3.

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[1] That is, in each case: $\frac{-\beta_0}{\beta_1} = \text{Ln}\ (C) = \text{Ln}(.02)$.

TABLE 4.5.3

CONDITIONS FOR EXPERIMENT SET II

GENERAL CONDITIONS:

1. P_o = 550 (in thousands)
2. K_o = 1000 (in millions of 1961$)
3. $f = f_n$ = .363
4. $n = n_n$ = .02
5. d = .08
6. $Ln(A) = Ln(A_n)$ = -.1
7. r = .02
8. $\alpha = v$ = .3

SPECIFIC CONDITIONS:

[Note: $M_{it} = \beta_0 + \beta_1 L_n(R_{it}) + \beta_2 M_{it-1} + \beta_3 I_{it}$; and $I_{it} = S_{it} = a_1 Q_{it-1} + a_2(RK_{it-1} - 1) + a_3 I_{it-1}$]

EXPT	β_0	β_1	β_2	β_3	a_1	a_2	a_3
2a:	-1	50	0	0	.15	200	0
2b:	-2	100	0	0	.15	200	0
2c:	-8	400	0	0	.15	200	0
2d:	-2	100	0	-.05	.15	200	0
2e:	-2	100	0	0	.15	800	0
2f:	-1	50	0	0	.15	0	0

The time paths for the relative regional wage rate associated with these experiments are set out in Fig. 4.5.2. An examination of these reveals some rather interesting features of the adjustment process. First, in all cases a steady state is reached where the regional and national wage rates grow at the same rate so as to produce a constant relative wage differential. In most cases, this equilibrium is reached in only about 10 periods even though the initial regional wage was almost 20 per cent less than the national wage.[1] Second, and even more interesting is the result that the equilibrium wage differential is much greater than that predicted by static models, and is not determined by the magnitude of the costs associated with interregional capital and labor movements. Rather, from an examination of the results of the experiments it appears that its size is determined by the elasticities of migration with respect to per capita income differentials and the growth of the capital stock and by the elasticity of investment with respect to return differentials.

The approximate effects of changes in the response of migration to per capita income differentials can be determined through a comparison of the time paths for the relative regional wage associated with EXPTs 2a, 2b and 2c. It can be seen that, while a 100 per cent increase in β_1 from 50 to 100 produces a 1 per cent increase in the steady state relative wage, a 300 per cent increase in β_1 from 100 to 400 produces only a 2 per cent increase in the steady state relative wage.

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[1] In all cases a steady state where the year-to-year change in the relative regional wage is less than 1/20 of one per cent is reached by the 30th period (year).

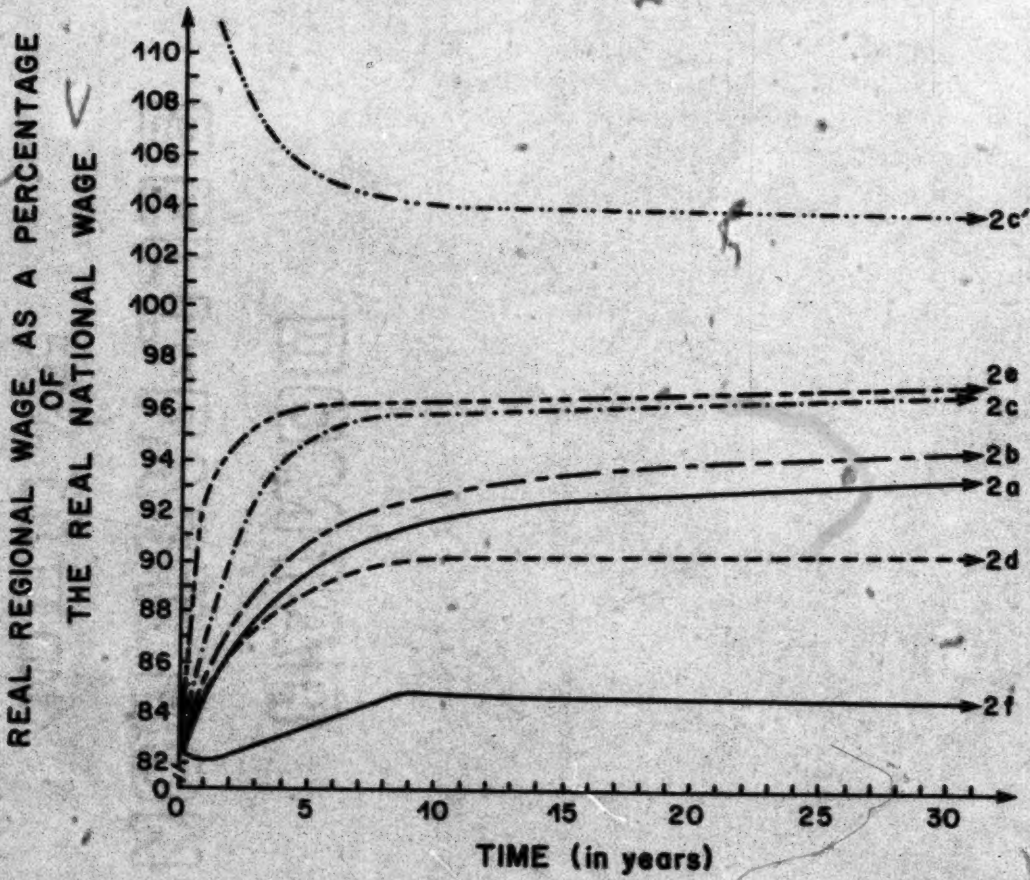

FIGURE 4.5.2

RELATIVE REGIONAL WAGE TIME PATHS FOR EXPERIMENT SET II

Thus it would appear that while the equilibrium is sensitive to the migration response parameter, β_1, this sensitivity is non-linearly related to the size of the parameter. It is also worth noting that the higher migration response produces a significantly shorter adjustment period. For example, in 2c the relative regional wage is within .5 per cent of the equilibrium relative wage within only 10 periods compared to about 20 periods for cases 2a and 2b.

The addition of the regional investment variable to the migration function appears to substantially alter both the length of time required to reach an equilibrium and the level of the equilibrium. It can be seen by comparing 2b and 2d that the addition of this factor shortens this time by about 15 periods and results in an equilibrium relative wage which is more than 4 per cent lower. This latter result is related to the fact that in EXPT 2d, while the increased investment associated with the inflow of capital tends to raise the regional capital-labor ratio (and hence the regional wage rate), it also tends to reduce out-migration (and thus increase regional labor supplies) which in turn reduces the equilibrium capital-labor ratio below that which would otherwise exist.

A comparison of the results for EXPTs 2b and 2e and EXPTs 2a and 2f gives some idea of the effect which changes in the response of regional capital formation to return differentials have on relative regional wage rates. First, comparing 2b and 2e it is seen that a 300 per cent increase in the response parameter a_2 has approximately the same effect on the relative wage pattern as the same increase in the migration response parameter. That is, it shortens the time required to reach equilibrium by about 10 periods and increases the equilibrium relative wage by about 2 per cent.

A comparison of the time paths for 2c and 2f indicates the effects of decreasing the responsiveness of interregional capital flows to return differentials when the responsiveness of migration to income differentials is low. As can be observed, the addition of the assumption of completely immobile capital across regions reduces the equilibrium relative wage by almost 9 per cent.

From the results summarized above it can be seen that the equilibrium wage differential produced by the model always exceeds that predicted by static models. Further it is related, not to the costs associated with interregional factor movements, but rather to the elasticities of migration with respect to per capita income differentials and regional investment and by the elasticity of investment with respect to regional return differentials.

These particular results are not intuitively obvious. Clearly, if the results of the many interactions and feed-backs embodied in the model were easily determined, there would be no need for numerical analysis. In any case, some insights can be gained by going through several of the steps in the adjustment process for a hypothetical case.

Consider a case where the rate of productivity growth, the growth of capital, and the growth of labor are such that the national wage rate grows at 3 per cent per year, where the regional wage is initially significantly less than the national wage, and hence where, given identical production functions, the return to capital in the region exceeds that for the nation. Now in this case there will initially be an inflow of capital to the region of a size determined by the magnitude of the parameter on the return differential in the capital formation equation. Suppose that this inflow along with investment financed by regionally generated saving implies a growth rate for the regional capital stock of 4 per cent. Suppose further that given the initial wage and per capita income differential the migration response parameter is such that the rate of out-migration is equal to the natural rate of increase so that there is no growth in the region's labor force. Initially then, the region's wage will grow at 3.2 per cent, and therefore the relative regional wage must rise.[1] Now as this happens both the return to capital differential and wage differential must decrease thereby reducing the inflow of capital and the outflow of labor. This in turn must reduce the growth of the regional capital stock and increase the growth of regional labor, and hence depress the growth of the regional wage. Now this adjustment must continue until some relative wage and relative return to capital is reached where the given response parameters in the mobility functions produce just that growth of regional capital and labor such that the growth of the regional wage is exactly 3 per cent. At this point both the relative return to capital and labor stabilizes along with the rates of inflow and outflow of capital and labor respectively.[1]

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[1] Recall that $\frac{\dot{w}}{w} = r + \alpha\frac{\dot{K}}{K} - \alpha\frac{\dot{L}}{L}$. Here it is assumed that $r = 2$ per cent, $\alpha = .3$, $\frac{\dot{K}}{K} = 4$ per cent and $\frac{\dot{L}}{L} = 0$ per cent.

In general, it would appear that for given parameters in the investment equation, the more responsive is migration with respect to per capita income differentials, the smaller will be the equilibrium wage differential since for a given growth rate in the region's capital stock, the smaller will be the wage differential (and hence per capita income differential) required to maintain a given growth of regional labor such that the growth rate of the regional wage is 3 per cent. Similar reasoning can be used to show that the higher is the response of capital formation to return differentials, ceteris paribus, the smaller should be the equilibrium wage differential. These predictions are borne out by the experiments.

It should be noted that an equilibrium differential equal to factor mobility constraints as predicted by static models is only assured in the dynamic case if there is an infinite elasticity of migration with respect to per capita income differentials and/or an infinite elasticity of investment with respect to return differentials. In addition, unlike the static models which require the rate of migration to approach zero as equilibrium is reached, this model implies that the rate of migraton approaches some positive constant rate as the steady state is reached. The latter is generally more consistent with observed migration patterns.[1]

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[1] If $\frac{\dot{w}_i}{w_i} = 3 = \frac{\dot{w}_n}{w_n}$, then $\frac{w_i}{w_n}$ is constant.

In summary, the experiments in this set have deomonstrated that the model does produce an equilibrium relative wage differential. Furthermore this equilibrium wage differential is not determined by costs of factor movements or mobility constraints, and does not require regional differences in production functions, employment bases, or natural rates of increase. Rather, it was shown that for a slow-growth-region the size of this steady state differential is negatively related to the response of migration to per capita income differentials and the

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[1] The lack of any general long-run trend of decreasing interregional migration as predicted by static models, is evident in the following table. Note that while the model predicts constant rates of migration over time, these data indicate many short-run variations. In the context of the model, the latter might plausibly be explained by various shocks to the regional economies which produce a cyclical behavior. It will be recalled that the numerical analysis ignores these short-run variations.

ESTIMATED FIVE YEAR RATES OF NET MIGRATION BY PROVINCE, 1951-1971

PROVINCE	MIGRATION PER 1000 BASE POPULATION			
	1951-56	1956-61	1961-66	1966-71
Nfld.	+ 9.9	- 40.1	- 50.0	- 42.1
P.E.I.	- 69.8	- 38.2	- 38.4	- 27.7
N.S.	- 2[illegible].5	- 32.5	- 51.6	- 10.4
N.B.	- 43.2	- 31.1	- 54.9	- 32.5
Que.	+ 22.6	+ 23.6	+ 11.9	- 3.0
Ont.	+ 83.9	+ 59.9	+ 33.2	+ 54.7
Man.	0	- 6.7	- 26.2	- 28.3
Sask.	- 45.4	- 51.6	- 49.5	- 76.1
Alta.	+ 68.6	+ 56.1	+ 3.2	+ 35.3
B.C.	+109.5	+ 85.6	+ 72.1	+125.8

Source: Estimates based on data in Dominion Bureau of Statistics (Statistics Canada), Vital Statistics, various years, (Ottawa: Queen's Printer, Cat. 84-202).

response of capital formation to regional differences in the return to capital, and positively related to the response of migration to regional investment.[1] For a rapid-growth-region with an initial wage greater than the national wage, (see 2c′ in Fig. 4.5.2), the equilibrium wage differential will be negatively related to the response of in-migration to per capita income differentials and investment, and to the response of capital formation to return differentials.

4.5.4 EXPERIMENT SET III (DYNAMIC CASE)

The basic purpose of this set of experiments was to determine the effects which regional differences in employment bases, output elasticities, and overall levels of factor productivity have on the size of the equilibrium wage differential.[2] In all cases the same mobility functions were used, along with the same natural rates of increase for the region and the nation. EXPT 3a, where the same employment bases and production functions were assumed for the nation and the region serves as a benchmark for the other experiments. EXPT 3b assumes a regional employment base which is only 95 per cent of the national employment base with all of the other parameters equal to those in 3a, while EXPT 3c assumes a lower elasticity of output with respect to capital for the region than the nation with all of the other parameters equal to those in 3a. In EXPT 3d, the equilibrium relative regional wage associated with a lower level of factor productivity in the region relative to that in the nation (that is, associated with a smaller scalar in the regional production function) is generated. The conditions for this set of experiments are summarized in Table 4.5.4.

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[1] It should be noted that for the slow-growth-region case for example, the equilibrium path for a given set of parameters is independent of the initial relative wage. The only restriction in this case is that the initial regional wage be less or equal to the initial national wage. Thus in any particular case there may initially be convergence or divergence depending on the initial relative wage in relation to the equilibrium relative wage.

[2] The effects of regional differences in other parameters such as the natural rate of increase or the rate of productivity growth, should be clear from the analysis in section 4.4.

TABLE 4.5.4

CONDITIONS FOR EXPERIMENT SET III

GENERAL CONDITIONS:

1. P_o = 550 (in thousands)
2. K_o = 1000 (in millions of 1961$)
3. f_n = .363
4. $n = n_n$ = .02
5. d = .08
6. $Ln(A_n)$ = -.1
7. r = .02
8. v = .3
9. β_0 = -2, β_1 = 100, β_2 = 0, β_3 = -.05
10. a_1 = .15, a_2 = 200, a_3 = 0

[Note: $M_{it} = \beta_0 + \beta_1 Ln(R_{it}) + \beta_2 M_{it-1} + \beta_3 I_{it}$; and $I_{it} = S_{it} = a_1 Q_{it-1} + a_2 (RK_{it-1} - 1) + a_3 I_{it-1}$]

SPECIFIC CONDITIONS:

EXPT	f	α	Ln(A)
3a	.363	.3	-.1
3b	.345	.3	-.1
3c	.363	.25	-.1
3d	.363	.3	-.2

The time paths associated with each of the experiments in this set are given in Figure 4.5.3. The path for EXPT 3b indicates that a decrease in the proportion of the population employed in the region relative to that in the nation has a tendency to reduce the equilibrium wage differential. It would appear that this is related to the fact that for a given wage differential such a change, ceteris paribus, increases the relative per capita income differential which in turn increases the rate of out-migration. This increased out-migration associated with the given wage differential thus reduces the growth of regional labor relative to the growth of regional capital, thereby providing for a higher capital-labor ratio and hence a higher equilibrium relative wage. For similar reasons, an increase in the employment base for a rapid-growth-region will, ceteris paribus, have a tendency to depress the regional wage toward the national wage.

EXPT 3c indicates that the equilibrium wage differential is negatively related to the magnitude of the elasticity of output with respect to capital in the region relative to that in the nation. This particular result however, is not intuitively obvious since it

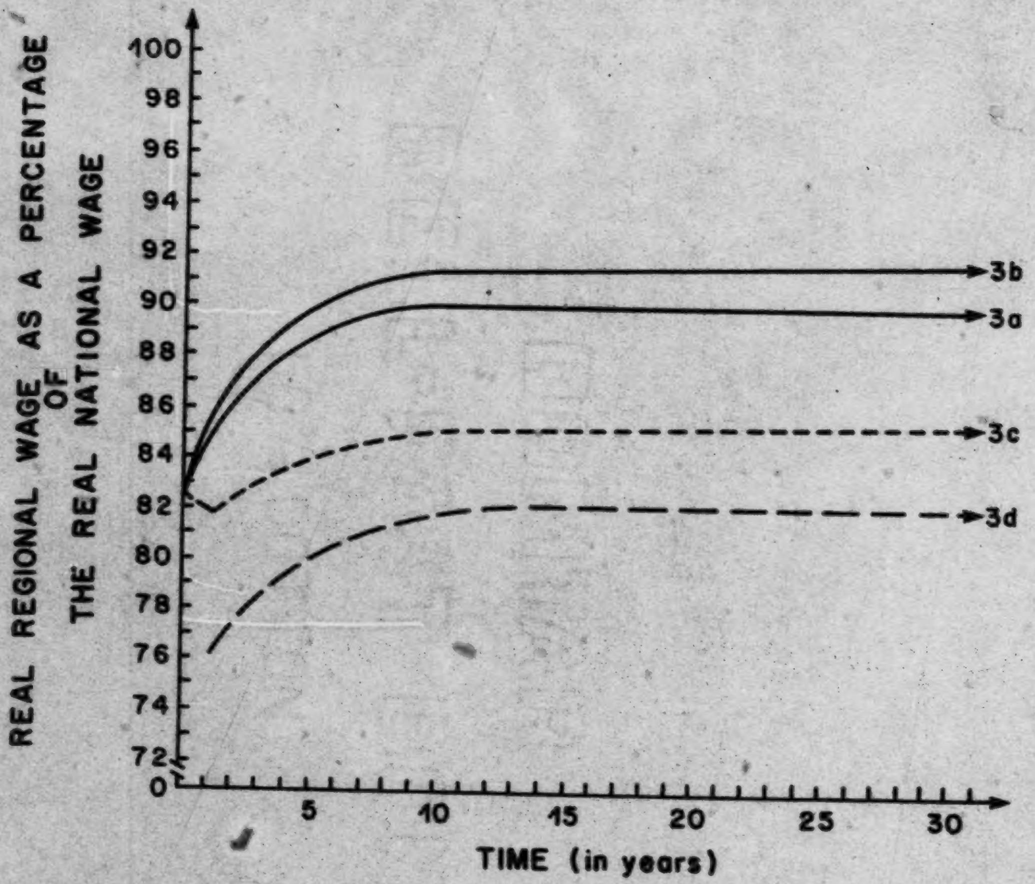

FIGURE 4.5.3

RELATIVE REGIONAL WAGE TIME PATHS FOR EXPERIMENT SET III is due to several rather complex interactions. Given this, only a rather loose explanation is possible.

For an initial output-capital ratio in the region, a decrease in the output elasticity (α) means a decrease in the return differential and hence a lower growth rate for the regional capital stock. The effect of this is to decrease the growth of regional output and wage rates.[1] At the same time, the lower α implies a higher wage associated with the initial output-labor ratio and this in turn means a lower rate of out-migration and hence a higher rate of growth in the region's labor supply. From this it would appear that this effect on the growth of labor and the effect on the growth of capital is large relative to any positive effect which a lower α has on the growth of the region's wage rate so that a smaller equilibrium relative wage rate is called for.

Finally, from examining the results of EXPT 3d it would appear that because, for any given capital-labor ratio, a decrease in the overall level of productivity means a fall in the wage rate, this new equilibrium relative regional wage is lower.

4.5.5 EXPERIMENT SET IV (DYNAMIC CASE)

It has already been shown that the model does generate an equilibrium regional wage differential. The purpose of this section then was to investigate the stability of this equilibrium under conditions where the regional economy received shocks in the form of increases or decreases in exogenous savings and hence investment. These were viewed as being related to such things as the discovery of a valuable resource in the region, the discovery of a ubiquitous substitute for one of the region's principle resources, or changes in federal government industrial incentive grants.

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[1] Recall that, $\frac{\dot{Q}}{Q} = r + \alpha\frac{\dot{K}}{K} + (1-\alpha)\frac{\dot{L}}{L}$, and $\frac{\dot{w}}{w} = r + \alpha\frac{\dot{K}}{K} - \alpha\frac{\dot{L}}{L}$.

Six experiments were conducted in this set. EXPTs 4a and 4d serve as benchmarks for the respective cases where out-migration is independent of the rate of regional investment and where it is negatively related to the rate of regional investment. In EXPTs 4b and 4e the region receives a shock involving an increase of $25 million in exogenous investment in each period after the 13th period. This represents about a 13 per cent increase in the rate of regional investment. In EXPTs 4c and 4f on the other hand, the region receives a decrease of $25 million in exogenous investment in each period after the steady state is reached.

In all of the experiments in this set it was assumed that there was only partial adjustment in any one period and hence values were assigned for the parameters for lagged investment and lagged migration. The previous assumption of complete one-period-adjustment was dropped as it was felt that the existence of lagged adjustment would have an important bearing on the nature of the adjustment to shocks. The particular value chosen for the migration equation implies that 60 per cent of the desired migration in any one period takes place in that period.

The assumed conditions for EXPT Set IV are summarized in Table 4.5.5, and the results are presented in Figure 4.5.4.

TABLE 4.5.5

CONDITIONS FOR EXPERIMENT SET IV

GENERAL CONDITIONS:

1. P_o = 550 (in thousands)
2. K_o = 1000 (in millions of 1961$)
3. $f = f_n$ = .363
4. $n = n_n$ = .02
5 d = .08
6. $Ln(A) = Ln(A_n)$ = −.1
7. r = .02
8. $\alpha = v$ = .3

SPECIFIC CONDITIONS:

[Note: $M_{it} = \beta_0 + \beta_1 Ln(R_{it}) + \beta_2 M_{it-1} + \beta_3 I_{it}$; *and* $I_{it} = S_{it} = a_1 Q_{it-1} + a_2(RK_{it-1} - 1) + a_3 I_{it-1} + a_4$

EXPT	β_0	β_1	β_2	β_3	a_1	a_2	a_3	a_4	
								(Pd·0-13)	(Pd·14+)
4a:	-2	100	.4	0	.15	100	.1	0	0
4b:	-2	100	.4	0	.15	100	.1	0	-25
4c:	-2	100	.4	0	.15	100	.1	0	+25
4d:	-2	100	.4	-.05	.15	100	.1	0	0
4e:	-2	100	.4	-.05	.15	100	.1	0	-25
4f:	-2	100	.4	-.05	.15	100	.1	0	+25

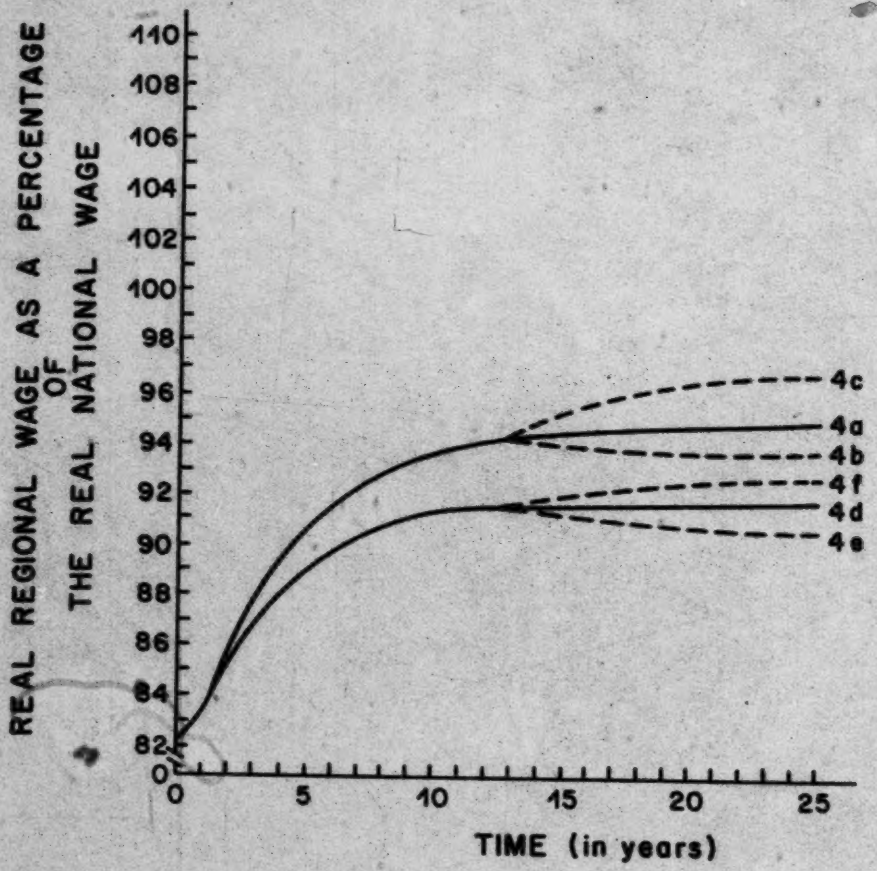

FIGURE 4.5.4

RELATIVE REGIONAL WAGE TIME PATHS FOR EXPERIMENT SET IV

An important conclusion to be reached from this set of experiments is that the inclusion of regional investment as an argument in the migration function has a significant dampening effect on shocks to the system. For example, comparing the paths for 4c and 4f reveals that while the increase in exogenous investment produces a 2 per cent increase in the relative regional wage when migration is independent of investment, this same increase produces less than a 1 per cent increase when migration is related to regional investment.[1] In the latter case, the increase in investment not only increases the growth of the region's capital stock, but also reduces out-migration. This decrease in out-migration in turn increases the growth in regional labor and thus tends to dampen the increase in the equilibrium capital-labor ratio and the relative regional wage.

It is also worth stressing that in either case, an increase in the response of migration with respect to per capita income differentials has the effect of reducing the increase in the equilibrium relative wage associated with an increase in exogenous investment. Similar results apply for the case where there is a decrease in exogenous investment and for the case of a rapid-growth-region where the relative regional wage is typically greater than or equal to the national wage.

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[1] Also note that the inclusion of investment as an argument in the migration equation significantly shortens the traverse between the equilibrium growth paths. Further, it should be noted that these types of shocks can produce short-run variations in interregional migration similar to those actually observed. Supra. p. 153, footnote 1.

4.6 SUMMARY

In this chapter a two region model of regional wage adjustment was presented along with an analysis of its basic characteristics. With respect to the latter, the main determinants of the growth rate of the regional wage and the conditions for convergence of regional wage rates in a modified version of the model were outlined. More importantly however, it was shown, using a numerical analysis of the complete model, that the model possesses a high degree of stability and generates an equilibrium regional wage differential that under most conditions will exceed that predicted by static models of regional wage adjustment. Further, it was shown that the size of the equilibrium differential is particularly sensitive to the responsiveness of migration with respect to per capita income differentials and the rate of real capital formation in the region. The effects of changes in these parameters on the size of the equilibrium wage differential, along with the effects of changes in other parameters which might normally be expected to vary significantly across regions are summarized for both the slow-growth-region case and the rapid-growth-region case in Table 4.6.1 below.

It was also shown that significant shocks to the regional system in the form of increases or decreases in exogenous investment tend to have little effect on the level of the equilibrium wage, particularly when migration is significantly related to the rate of regional investment and when migration is responsive to per capita income differentials.

TABLE 4.6.1

EFFECTS OF CHANGES IN THE VALUES OF KEY PARAMETERS ON THE EQUILIBRIUM REGIONAL WAGE DIFFERENTIAL

Case A: Slow-Growth-Region $(w_i \leq w_n)$ $[\bar{w} = (w_n - w_i)/w_i]$

$\frac{d\bar{w}}{d\beta_1}$	$\frac{d\bar{w}}{d\beta_3}$	$\frac{d\bar{w}}{da_2}$	$\frac{d\bar{w}}{d(\frac{f}{f_n})}$	$\frac{d\bar{w}}{d(\frac{\alpha}{v})}$	$\frac{d\bar{w}}{d(\frac{Ln(A)}{Ln(A_n)})}$
-	-	-	+	-	-

Case B: Rapid-Growth-Region $(w_i \geq w_n)$ $[\tilde{w} = (w_i - w_n)/w_n]$

$\frac{d\tilde{w}}{d\beta_1}$	$\frac{d\tilde{w}}{d\beta_3}$	$\frac{d\tilde{w}}{da_2}$	$\frac{d\tilde{w}}{d(\frac{f}{f_n})}$	$\frac{d\tilde{w}}{d(\frac{\alpha}{v})}$	$\frac{d\tilde{w}}{d(\frac{Ln(A)}{Ln(A_n)})}$
-	-	+	-	+	+

Finally, it is worth pointing out that the predictions of the model are generally consistant with the observed trend in Canadian regional wage inequality (discussed in Chapter II), regardless of whether that trend is interpreted as a long-run constancy or a very slow convergence toward some long-run equilibrium. It has been shown that while the model always produces a steady state equilibrium wage differential, under certain conditions (see for example, EXPTS 2a and 2b) the rate of convergence to this equilibrium is very slow. Although the interpretation of the Canadian trend used in this study is that of a long-run constancy (with the cases of British Columbia and Newfoundland constituting exceptions), the alternative interpretation of a very slow convergence and its consistency with the predictions of the model should be kept in mind.

CHAPTER V

AN APPLICATION OF THE MODEL OF REGIONAL WAGE ADJUSTMENT: THE CASES OF ALBERTA AND NOVA SCOTIA

5.1 INTRODUCTION

It will be recalled that the basic problem set out in this thesis involved explaining the constancy[1] and the degree of regional wage inequality in Canada. This, it was indicated, would go a long way towards explaining the observed trend in regional income inequality. In this chapter then, an attempt is made to relate the model of regional wage adjustment presented in the previous chapter and its predictions to the Canadian case with a view to providing such an explanation.

A two step procedure will be followed in applying the model. First, the model will be estimated using regional data to determine whether there is any empirical support for the basic hypotheses embodied in the model. These include the relation of migration to per capita income differentials and regional investment, of regional capital formation to regional output and return differentials, of regional output to regional capital and labor inputs, and of regional wage rates to the marginal product of labor. If there is support for these relationships, and hence the interactions and adjustments embodied in the model, the observed trends in wage inequality can be interpreted as some long-run equilibrium of the type which the model produced.

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[1] See p. 165.

Second, if there is support for the model some general hypotheses regarding the size of regional wage inequalities can be formulated and tested. For example, one hypothesis based on the analysis of the model presented in Chapter IV is that the size of regional wage inequalities is negatively related to the responsiveness of migration to per capita income differentials. Such a hypothesis can be tested by comparing the estimated response parameters for Canadian regions.

Although the above types of tests should ideally involve all 10 Canadian regions in order to insure a degree of generality for any explanation of regional wage inequality, this is not possible at this time. The most important limiting factor in this respect is the lack of output data on a regional basis. Since it would be a major undertaking to construct a consistent series for regional output[1] the only alternative was to base the tests on regions for which this data currently exists. Given this limitation two possible choices were Alberta and Nova Scotia. In each case estimates of aggregate regional output going back to at least 1950 have been prepared.

There are however, several other reasons for choosing these two regions for tests of the model. First of all, both economies are small relative to the national economy so that the assumption that there are no significant feedbacks from the region to the nation should hold. Second, in each case there has been no significant change in either the relative regional employment base or the relative regional wage rate, at least over the period of time for which data exists. As was indicated in Chapter II, the relative employment base and wage rates for Nova Scotia have remained at about 92 per cent and 74 per cent respectively, while for Alberta they have remained at about 103 per cent and 99 per cent respectively over the same period.

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[1] For a thorough discussion of the problems involved and efforts to estimate regional accounts, see Hans J. Adler, "Approaches to Regional Economic Accounting in Canada," Review of Income and Wealth, Series 16 (June, 1970), pp. 185-208, and T.K. Rymes, "Some Comments on Regional Economic Accounts," in T.N. Brewis, Regional Economic Policies in Canada (Toronto: Macmillan, 1969), Appendix B.

Perhaps even more important from the point of view of studying the wage adjustment process, both Alberta and Nova Scotia represent cases where this trend in the relative regional wage rates has been maintained in spite of rather large and different shocks to the regional economy. In the case of Alberta this period witnessed rapid economic growth, much of which was attributable to the development of the province's energy resources. In Nova Scotia's case there was a continued decline in two of the region's important industries, steel and coal, and a relatively slow rate of economic growth over this same period.

Finally, it should be noted that given that both of these regions have experienced substantial adjustments over this period many of the regional variables should show a good degree of variability over time and this should reduce some of the problems associated with the estimation of the model.

5.2 EXPLAINING THE CONSTANCY OF REGIONAL WAGE INEQUALITY: HYPOTHESIS I

5.2.1 VALIDATION OF THE MODEL

The first step in developing an explanation of the trends in wage inequality for the regions chosen involves the empirical validation of the model. This requires the estimation of the hypothesized relationships in the model (that is, the migration equation, the savings (capital formation) equation, the production equation and the wage equation) for each region in order to determine whether there is any general support for the model. As already noted, if such support exists the observed constancy of relative wage rates for Alberta and Nova Scotia can plausibly be interpreted as a long-run equilibrium of the type produced by the model.

In general, the validation of an economic model involves proving that the model is "true." In turn, this requires that a set of criteria for differentiating between a model which is "true" and one which is "not true" be established. It is in this area that there are numerous unresolved methodological issues,[1] many of which are related to setting out a widely accepted set of criteria for evaluating such models. In light of these problems, the approach used here is to concentrate on establishing the "degree of confirmation" of the model rather than whether or not the model is validated.[1] Using this approach then, only qualitative judgements with respect to the applicability of the model to the cases of Alberta and Nova Scotia are made.

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[1] These problems are similar to those associating with validating stochastic simulation models. For a discussion of the latter, see Thomas N. Naylor and J.M. Finger, "Validation," in Computer Simulation Experiments with Models of Economic Systems, pp. 153-164, edited by Thomas H. Naylor (New York: John Wiley and Sons Inc., 1971).

The particular hypothesis to be tested in this section can be stated as follows:

HYPOTHESIS I: The observed constancy in relative wage rates in Alberta and in Nova Scotia represents a long-run equilibrium produced by the same interactions and adjustments as embodied in the model of regional wage adjustment, and therefore the model is generally confirmed by the data.

This of course is the alternative hypothesis. The null hypothesis is that the observed constancy in relative wage rates in these two regions does not represent a long-run equilibrium of the type produced by the model, and therefore the model is not generally confirmed by the data.

The equations of the model to be estimated are summarized in 5.2.1 to 5.2.10 below. The a priori restrictions on the parameters are given in brackets. The subscripts c, a and ns denote variables for Canada, Alberta, and Nova Scotia respectively, ^ denotes estimated parameters, and u denotes a disturbance term. The other variables and parameters are defined exactly as in Chapter IV.

5.2.1 $Q_{ct} = A_c e^{rt} K_{ct}^{v} \; L_{ct}^{1-v} \, {}^{u_{1t}}; \; (r \geq 0, \; 0 < v < 1)$

5.2.2 $W_{ct} = h_0 + h_1[(1-\hat{v})Q_{ct}/L_{ct}] + u_{2t}; \; (h_1 = 1$

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[1] This follows a general approach suggested by K.R. Popper; see Karl R. Popper, The Logic of Scientific Discovery (New York: Basic Books, 1959).

5.2.3 $Q_{at} = A_a e^{rt} K_{at}^{\alpha} L_{at}^{1-\alpha} e^{u_{3t}}$; $(r \geq 0,\ 0 < \alpha < 1)$

5.2.4 $w_{at} = h_0 + h_1[(1-\hat{\alpha})Q_{at}/L_{at}] + u_{4t}$; $(h_1 = 1)$

5.2.5 $I_{at} = a_0 + a_1 Q_{at-1} + a_2[\hat{\alpha}(Q_{at-1}/K_{at-1})/\hat{v}(Q_{ct-1}/K_{ct-1})]$
$+ a_3 I_{at-1} + u_{5t}$; $(0 < a_1 < 1,\ a_2 \geq 0,\ 0 \leq a_3 \leq 1)$

Note: $a_0 = a_4 - a_2$ (see Equation 4.3.21)

5.2.6 $M'_{at} = \beta_0 + \beta_1 Ln[(Q_{at}/P_{at})/(Q_{ct}/P_{ct})] + \beta_2 M'_{at-1}$
$+ \beta_3 I_{at} + u_{6t}$; $(\beta_0 < 0,\ \beta_1 \geq 0,\ 0 \leq \beta_2 \leq 1,\ \beta_3 > 0)$

5.2.7 $Q_{nst} = A_{ns} e^{rt} K_{nst}^{\alpha} L_{nst}^{1-\alpha} e^{u_{7t}}$; $(r \geq 0,\ 0 < \alpha < 1)$

5.2.8 $w_{nst} = h_0 + h_1[(1-\hat{\alpha})Q_{nst}/L_{nst}] + u_{8t}$; $(h_1 = 1)$

5.2.9 $I_{nst} = a_0 + a_1 Q_{nst-1} + a_2[\hat{\alpha}(Q_{nst-1}/K_{nst-1})/\hat{v}(Q_{ct-1}/K_{ct-1})]$
$+ a_3 I_{nst-1} + u_{9t}$; $(0 < a_1 < 1,\ a_2 \geq 0,\ 0 \leq a_3 \leq 1)$

Note: $a_0 = a_4 - a_2$ (see Equation 4.3.21)

5.2.10 $M_{nst} = \beta_0 + \beta_1 Ln[(Q_{ct}/P_{ct})/(Q_{nst}/P_{nst})] + \beta_2 M_{nst-1}$
$+ \beta_3 I_{nst} + u_{10t}$; $(\beta_0 < 0,\ \beta_1 \geq 0,\ 0 \leq \beta_2 \leq 1,\ \beta_3 < 0)$

It should be noted that several of the above equations are slightly different from those in the original model. First, a constant term, h_0, has been introduced into each of the wage equations. This was done to take account of the possibility that the proxy variable (earned income), which had to be used since data for average regional wages do not exist, may consistently under-estimate or over-estimate regional wage income. Secondly, a_4 was incorporated into the saving or capital formation equations to take account of exogenous regional capital formation. Also it should be noted that M'_{at} represents migration to Alberta in period t while M_{nst} represents migration from Nova Scotia in period t.

5.2.2 THE DATA

The above equations were estimated using data for the period 1950-1971. The output figures used were real Canadian GNP (in millions of 1961$), real Alberta Gross Domestic Product (GDP), (in millions of 1961$), and real Nova Scotia Gross Regional Product (GRP) (in millions of 1961$). In each case the real values were derived by deflating the current values by the National GNE deflator with base = 1961.[1] While it would have been preferable to use provincial measures of output which are conceptually identical to the national concept, this was not possible since no such series exists. Instead, existing series for Alberta GDP and Nova Scotia GRP were used.[2]

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[1] Current dollar GNP is found in: Statistics Canada, National Income and Expenditure Accounts, 1971 (Ottawa: Queen's Printer, 1972) Cat. 13-531. Estimates for Alberta GDP for the period 1947-1972 are provided in: Alberta Bureau of Statistics, Alberta Statistical Review, August 1973 (Edmonton: Alberta Bureau of Statistics, 1973), p. 21. Estimates for Nova Scotia GRP for the period 1950-1965 are found in: K.S. Wood, Income and Product Accounts of Nova Scotia (Institute of Public Affairs, Dalhousie University, 1970). Estimates of GRP for the period 1966-1971 were derived on the basis of the relationship between GRP and Earned Income for the period 1950-1965.

[2] Note that GRP is the market value of gross output produced during a given year by factors of production owned by residents of the region, while GDP is the market value of gross output produced by factors of production within the geographical boundaries of the region. The

Since capital stock figures for Canada or the regions do not presently exist they had to be estimated. The estimation procedure which was used and which is outlined in detail in Appendix II employs the identity:

$$5.2.11 \quad K_t = K_{t-1}(1-d) + I_t$$

It will be recalled that I_t is defined as real gross capital formation in period t. Data for capital expenditures in the form of construction (c) and machinery and equipment (m & e) are available for Canada and each of the provinces from 1951 to 1973.[1] These values were deflated by the national price index (with base = 1961) for construction expenditures and machinery and equipment expenditures to get a series for aggregate real gross capital formation (in millions of 1961$) for each of Canada, Alberta and Nova Scotia.

These figures for real gross regional investment were also used as proxies for real gross regional saving (which includes saving within the region and saving outside of the region which is transferred to the region) in the estimation of equations 5.2.5 and 5.2.9. This procedure is suitable given the type of model involved.

Although estimates of annual employment for the 5 Canadian

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relationship between GRP and GDP should have remained relatively constant over time. For Canada, GNP has averaged about 99 per cent of GDP. See Alberta Bureau of Statistics, Alberta Statistical Review, August 1973 (Edmonton: Alberta Bureau of Statistics, 1973), p. 21.

[1] Information Canada, Private and Public Investment in Canada, various years, (Ottawa: Queen's Printer) Cat. 61-205.

regions are readily available for the period 1966-1971[1] such estimates on a provincial basis are not available for the period prior to 1966. For the province of Nova Scotia, however, annual employment for the period 1950-1965 has been estimated by Czamanski[2] so that a complete series for the period 1950-1971 is available. In Alberta's case estimates of annual employment prior to 1966 were made using 1951 and 1961 Census data on the labor force[3] and several other occasional series.[4] For years where no information was available on Alberta employment the estimates were based on a trend line of Alberta employment relative to Prairie employment fitted for the years 1951, 1956, 1961 and 1966 to 1974. These estimates were then checked against estimates derived using annual population figures and estimates of Alberta unemployment rates, participation rates and the age structure of the provincial population.[1] Alberta unemployment rates and participation rates were estimated using a fitted trend line similar to that outlined above. Estimates of annual employment for Canada for the complete period 1950-1971 are readily available.[2]

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[1] These are available in Dominion Bureau of Statistics (Statistics Canada), The Labour Force, various years, (Ottawa: Queen's Printer) Cat. 71-001. Estimates for employment in each province for the period 1966-1971 can also be found in these publications.

[2] These are given in: Stanislaw Czamanski, An Econometric Model of Nova Scotia, (Institute of Public Affairs, Dalhousie University, 1968). It should be noted that the estimates for 1963, 1964 and 1965 were revised slightly so they would be consistent with the 1966 estimate based on labor force surveys.

[3] These are summarized in S. Ostry, Geographic Composition of the Labour Force, 1961 Census Monograph (Ottawa: Queen's Printer), Cat. 99-554.

[4] These include: Dominion Bureau of Statistics (Statistics Canada), Estimates of Employees by Province and Industry, various months (Ottawa: Queen's Printer), Cat. 72-008 and, Estimates of Employees by Province and Industry, 1961-64 (Ottawa: Queen's Printer), Cat. 72-503.

The annual rate of migration for each of the regions can be estimated using the identity:

$$5.2.12 \quad P_t \equiv P_{t-1} + NI_{t-1} \pm M_{t-1}$$

However, since the provincial population figures are on a June 1 basis, while those for births minus deaths (or natural increase) are on a January-December basis,[3] an adjustment had to be made to this relation. On the assumption that the annual natural increase in the population is spread evenly over the year, the annual rate of migration between June 1 of year t-1 and June 1 of year t, M_{t-1}, was determined by:

$$5.2.13 \quad M_{t-1} \equiv P_t = P_{t-1} - 7/12(NI_{t-1}) - 5/12(NI_t);$$

where P_t = the provincial population on June 1 of year t, and NI_t = the natural increase in the provincial population from January to December of year t. It should be noted that this method of estimating migration assumes that there are no births or deaths among the migrants in the

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[1] Recall, $L_t = (1-u_t)p_t \cdot s_t \cdot P_t$; where L_t = employment, u_t = unemployment rate, p_t = participation rate and s_t = proportion of the region's population which is classified as labor force source population.

[2] Dominion Bureau of Statistics (Statistics Canada), The Labour Force, various years (Ottawa: Queen's Printer), Cat. 71-001.

[3] These are given in: Dominion Bureau of Statistics (Statistics Canada), Vital Statistics, various years (Ottawa: Queen's Printer), Cat. 84-202.

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year in which the change of residence takes place.[1]

It must be emphasized that the procedures used in estimating interregional migration and capital stocks are quite imperfect. To the extent that there is a natural increase among migrants in the year in which the change of residence takes place, the estimates of the change in population due to migration from this method will tend to be under-estimates of that due to in-migration and over-estimates of that due to out-migration. In most cases where annual migration is small in relation to the total regional population the extent of these biases should be slight.

The Cumulation procedure was used to derive the estimates of capital stocks for Canada, Nova Scotia and Alberta. While there are several other procedures which have been used it was not possible to employ them here due to various data limitations. There are several deficiencies in the data estimated using the Cumulation approach. First, it was necessary to assume that the prices of capital goods are equalized across regions since price deflators for these goods are not available on a regional basis. Since a large proportion of the capital goods are manufactured in Eastern Canada and since the regional prices of capital goods should to some extent reflect transportation costs, the assumption of identical costs may produce over-estimates of real capital stocks in outlying regions.

A second deficiency in the capital stock estimates is due to a lack of data on actual depreciation rates by type of capital. While

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[1] The estimates of annual migration for Alberta and Nova Scotia are given in Appendix III.

Hood and Scott[1] have produced some estimates of the useful lives of various types of capital, the estimates are not on a regional basis and are largely out of date. In deriving the estimates an average annual rate of depreciation was used[2] and no account was taken of possible regional differences in rates of depreciation. In spite of these deficiencies it is believed that the estimated capital stocks used in this study are reasonable approximations.[3]

5.2.3 ESTIMATING THE MODEL

Since linear estimation procedures were employed the non-linear production functions were recast in log form so as to be log-linear. In addition, to avoid any problems of multicollinearity due to the probable high correlation between capital and labor these functions were estimated in ratio form. That is, the estimated production functions were of the form:

$$5.2.14 \quad Ln(Q_t/L_t) = Ln(A) + rt + \alpha Ln(K_t/L_t) + u_t$$

If the equations of the model are written in the form:

5.2.15 $By_t + \Gamma x_t = u_t$; where B is a G x G matrix of coefficients of current endogenous variables, y_t is a column vector of G current endogenous variables, Γ is a G x K matrix of coefficients of predetermined variables, x_t is a column vector of K predetermined variables and u_t is a column vector of G disturbances, it can be shown that the B matrix is triangular and the determinant of B is unity. That is, the model is recursive. Now, on the assumption that Φ, the G x G matrix of the variances and covariances of the disturbances,[1] is diagonal[2] it can be shown that the method of Ordinary Least Squares (OLS) will provide consistent estimates of the parameters in the model.[3] Hence, under these conditions OLS is an acceptable procedure for estimating the model.

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[1] William C. Hood and Anthony D. Scott, Output, Labour and Capital in the Canadian Economy, a study published by the Royal Commission on Canada's Economic Prospects (Ottawa: 1957), Chapter 6, Appendix C.

[2] See Appendix II.

[3] See Appendix II.

A characteristic of the model which could create estimation problems is that it includes lagged dependent variables in both the migration and capital formation equations. Although OLS does produce consistent estimates for the parameters of an equation with a lagged dependent variable these estimates tend to be biased toward zero.[4] More importantly however, in the case where there is both a lagged dependent variable and autocorrelation OLS not only produces inconsistent estimates but the Durbin-Watson (D.W.) statistic is biased toward 2, and thus it is difficult to even detect the problem. Although there are techniques available to deal with this type of estimation problem (for example, Three Pass Least Squares or Instrumental Variables) it was felt that, given the reasonableness of the OLS estimates and the lack of good instrumental variables on a regional basis, these techniques were not warranted.

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[1] That is, $\Phi = E(u_t u_t')$

[2] Or, in other words, the contemporaneous disturbances in the G structural relationships are not correlated.

[3] Under these conditions OLS is equivalent to FIML (Full Information Maximum Likelihood) which can be shown to provide consistent estimates. See J. Johnston, Econometric Methods (New York: McGraw-Hill Book Co., 1972) pp. 377-380.

[4] Sampling studies have indicated that this bias is approximately (1-2/N) where N = sample size. See E. Malinvaud, Statistical Methods of Econometrics (Amsterdam: North-Holland, 1966), Ch. 14.

5.2.4 ESTIMATED EQUATIONS

The OLS estimates of the equations of the model (equations 5.2.1 to 5.2.10 above) are summarized below in Table 5.2.1. It should be noted that: (i) the estimates are based on the sample period 1950-1971 unless otherwise specified, (ii) CORC indicates that the Cochrane-Orcutt technique was employed in the estimation procedure to correct for autocorrelation, (iii) the t values are given in brackets, and (iv)* indicates that the estimated coefficients are not significantly different from zero at the 1 per cent level of significance for n-k degrees of freedom where n = sample size and k = number of estimated parameters. R^2 is the simple coefficient of determination unadjusted for degrees of freedom and D.W. is the Durbin-Watson statistic.

TABLE 5.2.1

OLS ESTIMATES OF THE MODEL OF REGIONAL WAGE ADJUSTMENT

Eqtn. No.	Estimated Equation	
5.2.16(a)	$\text{Ln}(Q_{ct}/L_{ct}) = .125 + .019t + .237\,\text{Ln}(K_{ct}/L_{ct})$ $(.458)^{*}\ (4.846)\ (1.18)^{*}$	$R^2 = .984$ D.W. = 1.10
5.2.16(b)	$[\text{Ln}(Q_{ct}/L_{ct}) - .33\text{Ln}(K_{ct}/L_{ct})] = .057 + .017t$ $(.953)^{*}\ (17.158)$	$R^2 = .976$ D.W. = 2.01
5.2.17 (CORC)	$w_{ct} = .162 + .891[.67(Q_{ct}/L_{ct})]$ $(.570)^{*}\ (15.319)$	$R^2 = .994$ D.W. = 1.82
5.2.18	$\text{Ln}(Q_{at}/L_{at}) = -.068 + .015t + .373\text{Ln}(K_{at}/L_{at})$ $(-2.486)\ (75.734)\ (28.602)$	$R^2 = .996$ D.W. = 2.23
5.2.19	$w_{at} = .522 + .846[.63(Q_{at}/L_{at})]$ $(1.079)^{*}\ (7.714)$	$R^2 = .996$ D.W. = 1.50
5.2.20	$I_{at} = 1070.897 + .183Q_{at-1} - [1045.639]$ $(.927)^{*}\ (2.740)\ (-.838)^{*}$ $[.4(Q_{at-1}/K_{at-1})/.3(Q_{ct-1}/K_{ct-1})]$ $+ .395I_{at-1}$ $(1.742)^{*}$	$R^2 = .955$ D.W. = 1.85
5.2.21	$M'_{at} = -22.860 + 200.784\text{Ln}[(Q_{at}/P_{at})/(Q_{ct}/P_{ct})]$ $(-3.740)\ (4.827)$ $+ .471M'_{at-1} + .010I_{at}$ $(3.773)\ (3.031)$	$R^2 = .755$ D.W. = 2.10
5.2.22	$\text{Ln}(Q_{nst}/L_{nst}) = -.694 + .026t + .278\text{Ln}(K_{nst}/L_{nst})$ $(-15.185)(11.251)\ (3.837)$	$R^2 = .994$ D.W. = 2.00
5.2.23	$w_{ns} = .153 + .855[.72(Q_{nst}/L_{nst})]$ $(1.039)^{*}(21.709)$	$R^2 = .993$ D.W. = 2.03
5.2.24 (CORC)	$I_{ns} = 229.315 + .292Q_{nst-1} - [361.468]$ $(1.432)^{*}\ (2.897)\ (-1.961)^{*}$ $[.3(Q_{nst-1}/K_{nst-1})/.3(Q_{ct-1}/K_{ct-1})]$ $+ .227I_{nst-1}$ $(.856)^{*}$	$R^2 = .968$ D.W. = 1.68

TABLE 5.2.1 (Cont'd)

5.2.25(a) Sample = (1956-1971)	$M_{ns} = -11.709 + 34.701 Ln[(Q_{ct}/P_{ct})/(Q_{nst}/P_{nst})]$ $(-.999)^* \quad (1.469)^*$ $+ .476 M_{nst-1} - .003 I_{nst}$ $(2.397)^* \quad (-.318)^*$	$R^2 = .600$ D.W. = 1.73
5.2.25(b) Sample = (1961-1971)	$M_{ns} = -17.800 + 63.726 [(Q_{ct}/P_{ct})/(Q_{nst}/P_{nst})]$ $(-4.039) \quad (6.530)$ $+ .256 M_{nst-1} - .015 I_{nst}$ $(2.816) \quad (-4.035)$	$R^2 = .971$ D.W. = 2.47

It can be seen in 5.2.16(a) that while there was a good fit for the national production function the estimated coefficient for the elasticity of output with respect to capital was not statistically significant. Since these particular results suggested the existence of multicollinearity the relationship between t and Ln(K/L) was investigated. The correlation coefficient for this was 0.96. In order to deal with this problem of multicollinearity an extraneous estimate[1] for v was used so that the estimated national production function was of the form 5.2.16(b). Because of the greater variability in the regional capital-labor ratios multicollinearity was not a problem in the estimation of the production functions for Alberta (Eqtn. 5.2.18) and Nova Scotia (Eqtn. 5.2.22). As can be seen in Table 5.2.1 all of the estimated coefficients in these functions are highly significant and the functions fit the data very well.

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[1] Under competitive conditions as assumed in the model, labor's share of output ($w_c.L_c$) is: $w_c.L_c = (1-v)Q_c$. Using earned income as a proxy for wage income, it was found that over the period 1950-1971, $Y_{ec}/Q_c = .67$. From this v was estimated to be .33.

With respect to the wage equations (Eqtns. 5.2.17, 5.2.19 and 5.2.23) it is apparent that both the national and regional wage rates can be explained by the respective marginal products of labor. There it can also be seen that in every case the constant term is insignificant while the estimated coefficient for the marginal product of labor is highly significant but less than one. This would indicate that earned income (Ye) tends to underestimate labor's share, not by a constant absolute amount, but rather by a constant percentage amount.

Both of the regional saving (capital formation) equations (Eqtns. 5.2.20 and 5.2.24) provide a good fit with the estimated coefficient for lagged output significant in each case and satisfying the a priori restriction ($0 < a_1 < 1$). Further, while the estimated coefficient on lagged investment is significant only in the equation for Alberta it satisfies the a priori restriction in both cases. In the case of Alberta the estimated coefficient for the differential return to capital variable is not only insignificant, but also the wrong sign. This result may indicate that capital flows to (or from) Alberta are not in fact sensitive to return differentials, or it may be due to poor capital stock estimates or a lack of significant variability in the regional return differential. An investigation of the year to year variability in the return differential variable suggested that the lack of variability is part of the problem.

In the case of Nova Scotia this estimated coefficient (see Eqtn. 5.2.24) is of the wrong sign and in addition is significant at the 5 per cent level (although not at the 1 per cent level). This result may be related to the imperfect capital stock estimates used, or it may be due to changes in investors' views of the risks associated with investment in the various regions. For example, it may be that the return to capital in Nova Scotia relative to that in Canada typically rises in periods of generally slow growth during which investors view increased risk associated with investment in Nova Scotia relative to that associated with investment in the more prosperous regions.

The estimates for the regional migration functions are summarized in equations 5.2.21, 5.2.25(a) and 5.2.25(b). Examining first the migration equation for Alberta, (Eqtn. 5.2.21) it can be seen that not only does it possess a good degree of explanatory power (especially in comparison to that which has generally been achieved in other migration studies[1]), but also all of the estimated coefficients are significant and satisfy the a priori restrictions. The estimates for the constant term and the coefficient for per capita income or output differentials indicate that the mobility constraint for migration to Alberta is 12 per cent, and that at a relative per capita income differential equal to 115 per cent the elasticity of migration with respect to income differentials[2] is 38.9. In addition, the estimate for the coefficient on lagged migration implies a coefficient of partial adjustment of 0.53, and the estimate for the coefficient on the rate of real gross capital formation in Alberta indicates that an increase of $100 million in the latter produces an increase in annual in-migration of about 1,000 people.

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[1] See for example, John Vanderkamp, "Interregional Mobility in Canada: A Study of the Time Pattern of Migration," Canadian Journal of Economics, I, (August 1968), pp. 595-608.

[2] That is, $e^{-(-22.9/200.8)} = 1.12$ and $200.8/-22.9 + 200.8\mathrm{Ln}(1.15) = 38.9$.

In contrast to the Alberta migration equation the Nova Scotia equation yielded poor results when it was estimated using 1950-1971 data. Not only was the coefficient of determination relatively low but most of the coefficients were insignificant. An examination of the plotted values for this regression however, indicated that while the equation fitted the data reasonably well for the period 1956-1971, it did not fit the data for the period 1950-1956. A possible explanation for this is related to the fact that the defense establishment in Nova Scotia (which has been and remains an important part of the Nova Scotia economy)[1] played a key role in the Korean war. That is, it may have been that the pattern of Nova Scotia migration during the early part of the 1950-1956 period was largely determined by the inflow of defense personnel, while during the latter part of this period it was largely determined by the gradual removal of this expanded defense force. Thus, the long-run determinants of migration such as regional income differences may not have begun to re-assert themselves until the mid-1950's and may not have begun to dominate again until the late 1950's.

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[1] For example in 1961, 11.6 per cent of total employees in Nova Scotia were employees of the Federal Government Defense establishment. The comparable figure for Canada is 2.7%. (Based on data in Dominion Bureau of Statistics, 1961 Census of Canada, Labour Force (Ottawa: Queen's Printer) Cat. 94-551.)

This explanation appears to be consistent with the estimates reported in equations 5.2.25(a) and 5.2.25(b). In equation 5.2.25(a) which is estimated with 1956-1971 data it can be seen that while all of the estimated parameters satisfy the a priori restrictions they are not highly significant. The estimated parameters in equation 5.2.25(b) which were estimated with 1961-1971 data, in contrast, are all highly significant and of the proper sign. Furthermore, in comparing the two estimated equations it can be seen that the estimated response of migration to regional per capita income differentials is greater for the period 1961-1971, than the period 1956-1971.

If one accepts the above explanation the equation estimated for the period 1961-1971 is the most accurate representation of the long-run determinants of out-migration from Nova Scotia. Given this, the parameter estimates imply an elasticity of migration with respect to per capita income differentials of 7.2 (at a relative per capita income differential of 115 per cent). The estimate for the coefficient on lagged migration implies a coefficient of partial adjustment equal to 0.74, and the estimate for the coefficient on investment in Nova Scotia indicates that a $100 million increase in real gross capital formation in Nova Scotia produces a decrease in annual out-migration of about 1,500 people.

Given the above estimated equations for the model it can be concluded that the model of regional wage adjustment presented in Chapter IV is generally supported by the data. The equations fit the data remarkably well and almost all of the hypothesized relationships in the model appear significant. The only hypothesis embodied in the model for which there appears to be no support (at least with present capital stock estimates) is that interregional capital flows are related to regional differences in the marginal product of capital. It should be noted however, that as was shown in Chapter IV this has no bearing on whether or not the model produces a long-run constancy in regional wage inequality. Rather its importance lies in its effect on the size of the equilibrium wage differential.

With this evidence then, Hypothesis I is not rejected. Thus, it is argued that the observed constancy in relative wage rates in Alberta and Nova Scotia represents a long-run equilibrium produced by the same interactions and adjustments as embodied in the model. One type of adjustment which appears particularly important in terms of explaining the maintenance of this long-run equilibrium in spite of the large differences between the two regions in rates of investment is interregional migration. In Alberta's case for example, it appears that while rapid rates of investment augment the region's capital stock, these also increase the rate of in-migration to such an extent that the increase in labor prevents a rise in the relative capital-labor ratio and hence in the relative wage rate. An increase in the rate of investment directly increases in-migration to the province through its effect on employment opportunities, and indirectly increases in-migration through its temporary effect on relative per capita income. With respect to the latter, the increased investment temporarily increases the relative capital-labor ratio and hence the relative wage rate and per capita income. In turn, given the relatively high response of migration to per capita income differentials in the case of Alberta, in-migration increases significantly and thus dampens the initial increase in the capital-labor ratio.

Using similar reasoning for Nova Scotia it can be argued that any decreases in the rate of Nova Scotia investment relative to that in other regions directly and indirectly increase the rate of out-migration to such an extent that any fall in the relative capital-labor ratio and hence the relative wage rate is prevented.

5.3 EXPLAINING THE LEVEL OF WAGE INEQUALITY

5.3.1 FACTORS IN WAGE INEQUALITY

It will be recalled from the analysis in Chapter IV that one of the important determinants of the equilibrium level of wage inequality is the size of the regional employment base relative to that for the nation (that is, f/f_n). There it was shown that for a slow-growth-region the lower is f/f_n ceteris paribus, the higher will be the equilibrium wage. For a rapid-growth-region the higher is f/f_n, ceteris paribus, the lower will be the relative equilibrium wage. Given this then, the higher-than-average employment base in Alberta (a rapid-growth-region) and the lower-than-average employment base in Nova Scotia (a slow-growth-region) should be factors tending to reduce the equilibrium wage differential between these two regions.[1]

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[1] Although these two factors will, all other things equal, tend to have a negative effect on per capita income differentials.

Thus, in order to explain the large equilibrium wage differential between Alberta and Nova Scotia, other factors must be considered. Some of these are: i) differences in natural rates of increase in the population, ii) differences in production conditions (this includes differences in the rate of technical progress, average level of factor productivity and in the elasticity of output with respect to capital), iii) differences in saving or capital formation conditions (this includes differences in the propensity to save out of regional output and in the responsiveness of investment to regional return differentials), and iv) differences in migration conditions (this includes differences in the response of migration to per capita income differentials and investment). Each of these factors is analyzed below.

5.3.2 DIFFERENCES IN NATURAL RATES OF INCREASE

With respect to regional differences in natural rates of increase it was shown that the growth of a region's wage rate is negatively related to the natural rate of increase in the region's population. Given this, one would expect the equilibrium relative regional wage to be negatively related to the natural rate of increase. For the cases of Alberta and Nova Scotia this leads to the following hypothesis:

HYPOTHESIS II: The higher equilibrium wage in Alberta relative to that in Nova Scotia is at least partially due to a higher natural rate of increase in Nova Scotia compared to that in Alberta.

It should be clear that this is actually the alternative hypothesis. The null hypothesis is that the higher relative wage in Alberta is not due to a higher natural rate of increase in Nova Scotia compared to that in Alberta.

An examination of the data in Table 5.3.1 indicates that Hypothesis II must be rejected. It can be seen that over the 1950-1971 period the natural rate of increase in Nova Scotia has been consistently less than that in Alberta. Thus, the observed differences in natural rates of increase (although small) have been a factor tending to, ceteris paribus, raise the equilibrium wage in Nova Scotia relative to that in Alberta.

TABLE 5.3.1

NATURAL RATES OF INCREASE IN NOVA SCOTIA AND ALBERTA
1950-1971 (Rate per 1000 Population)

Year	Nova Scotia	Alberta	Year	Nova Scotia	Alberta
1950	17.6	20.6	1961	18.0	22.5
1951	17.6	21.2	1962	17.5	21.5
1952	18.7	22.4	1963	16.8	20.7
1953	18.8	23.4	1964	15.8	18.7
1954	19.6	24.7	1965	13.5	15.9
1955	19.1	24.2	1966	11.5	14.3
1956	19.2	24.2	1967	10.1	14.2
1957	19.1	23.6	1968	9.4	13.3
1958	18.1	23.7	1969	9.1	13.4
1959	17.6	23.7	1970	9.7	13.7
1960	17.9	23.3	1971	9.6	12.3

Source: Statistics Canada, Vital Statistics, 1973 (Ottawa: Queen's Printer, 1973), Cat. 84-202.

5.3.3 DIFFERENCES IN PRODUCTION CONDITIONS

5.3.3 a) Differences in the Average Level of Productivity

In the numerical analysis of the model of regional wage adjustment it was shown that a change in the average level of factor productivity for a region has a very significant effect on the relative equilibrium wage. In comparing regions, differences in the level of productivity could be related to such factors as differences in the level of industrial agglomeration, the quality of the labor force, the quality of capital or the quality and quantity of natural resources. In any case, with reference to the Alberta and Nova Scotia cases the following hypothesis can be stated.

HYPOTHESIS III: The higher equilibrium wage in Alberta relative to that in Nova Scotia is at least partially due to a higher average level of productivity in Alberta compared to that in Nova Scotia. Stated another way, the alternative hypothesis is that Ln(A) in the Alberta production equation is significantly larger than that in the Nova Scotia production equation.

A test of Hypothesis III is provided in 5.3.3 d) below.

5.3.3 b) Differences in Rates of Technical Progress

A second factor which might account for regional wage inequality is regional differences in rates of technical progress. In general, for any given region the higher the rate of technical progress the higher will be the equilibrium relative wage.[1] Given this, the following hypothesis is suggested.

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[1] It should be noted that in terms of the dynamic experiments in Chapter IV, an increase in the rate of technical progress produces the same effect on the equilibrium wage as an increase in the overall level of productivity.

HYPOTHESIS IV: The higher equilibrium wage in Alberta relative to that in Nova Scotia is at least partially due to a higher rate of technical progress in Alberta relative to that in Nova Scotia.

Testing this hypothesis involves testing whether the estimated coefficient on time in the Alberta production equation (Eqtn. 5.2.18) is significantly larger than that in the Nova Scotia production equation (Eqtn. 5.2.22). For this case the null hypothesis is that $\hat{r}_a - \hat{r}_{ns}$ is not significantly different from zero and the alternative hypothesis is that $\hat{r}_a - \hat{r}_{ns}$ is significantly greater than zero, where $\hat{r}_a$ and $\hat{r}_{ns}$ are the estimated rates of technical progress in Alberta and Nova Scotia respectively. A test of Hypothesis IV is provided in 5.3.3 d) below.

5.3.3 c) Differences in the Elasticity of Output with Respect to Capital or in Capital's Share of Output

Another possible difference in the production equations is in the elasticity of output with respect to capital (that is, α). It will be recalled that for the reasons outlined in Chapter IV a region's equilibrium relative wage is positively related to the magnitude of α. Given this relationship the following can be stated.

HYPOTHESIS V: The higher equilibrium wage in Alberta relative to that in Nova Scotia is at least partially due to a higher elasticity of output with respect to capital in Alberta than in Nova Scotia. That is, $\hat{\alpha}$ for Alberta is significantly greater than $\hat{\alpha}$ for Nova Scotia.

5.3.3 d) Tests of Hypotheses III-V

There are two statistical test procedures which can be used to test these hypotheses relating to differences in regional production conditions. The first is a Chow test based on an 'F' ratio and is designed to test for differences in subvectors of coefficients in the equations.[1] The second test, which is equivalent to the Chow test in this case, uses dummy variables and a 't' statistic in the test procedure. Since the dummy variable technique is computationally simpler it will be used here.

In using this test procedure the regional samples are first pooled and an equation with dummy variables to take account of possible regional differences in both intercept and slope coefficients is estimated. The production equation to be estimated with the pooled data is:

$$5.3.1 \quad \mathrm{Ln}(Q/L) = \mathrm{Ln}(A) + \gamma_0 D + rt + \gamma_1 Dt + \alpha \mathrm{Ln}(K/L) + \gamma_2 D\mathrm{Ln}(K/L) + e;$$

where Q/L = m + n vector of output - labor ratios (m values for Alberta plus n values for Nova Scotia), Ln(A) is the intercept term, D is a dummy variable and is equal to 0 for the m Alberta values and 1 for the n Nova Scotia values, t = time and K/L = m + n vector of capital-labor ratios, (m values for Alberta plus n values for Nova Scotia).

Now in this equation it can be shown that $\gamma_0 = \mathrm{Ln}(A_{ns}) - \mathrm{Ln}(A_a)$, $\gamma_1 = r_{ns} - r_a$, and $\gamma_2 = \alpha_{ns} - \alpha_a$. (The subscripts a and ns represent coefficients in the equations for Alberta and Nova Scotia respectively.) That is, these coefficients measure regional differences in the parameters in the production equations. When equation 5.3.1 is estimated the coefficients can thus be used to make inferences about regional differences in production conditions. For example, if the calculated t value for $\hat{\gamma}_1$ exceeds the critical t value (for m + n - G degrees of freedom, where G = total number of estimated parameters) the null hypothesis that $\hat{r}_{ns} - \hat{r}_a$ is not statistically different from zero must be rejected.

---

[1] G.C. Chow, "Tests of Equality between Sets of Coefficients in Two Linear Regressions," Econometrica, 28 (1960) pp. 591-605.

With this technique, the specific hypotheses to be tested are:

HYPOTHESIS III: $H_0: \gamma_0 = 0$

$H_1: \gamma_0 < 0$

HYPOTHESIS IV: $H_0: \gamma_1 = 0$

$H_1: \gamma_1 < 0$

HYPOTHESIS V: $H_0: \gamma_2 = 0$

$H_1: \gamma_2 < 0$

Using pooled data (44 observations) for Alberta and Nova Scotia, equation 5.3.1 was estimated with OLS. The results are presented in equation 5.3.2 (t ratios are given in brackets).

$$5.3.2 \quad \begin{array}{llllll} \text{Ln}(Q/L) = & .133 & - .826D & + .015t & + .011Dt & + .303\text{Ln}(K/L) \\ & (.823) & (-4.987) & (14.001) & (5.331) & (4.061) \\ & - .027D\text{Ln}(K/L) & & & & R^2 = .998 \\ & (-.287) & & & & D.W. = 2.01 \end{array}$$

Considering Hypothesis III first, a comparison of the t value for $\hat{\gamma}_0$ with the critical t value of 2.43 (for 44-6 degrees of freedom and 1 per cent level of significance) indicates that the null hypothesis is rejected and the alternative hypothesis is accepted. Thus it would appear that one of the factors accounting for the low equilibrium wage in Nova Scotia relative to that in Alberta is the lower average level of factor productivity in Nova Scotia. Some additional comments on this particular result will be made in a later section.

On the basis of the estimates in equation 5.3.2, and a test at the 1 per cent level of significance, both the null and the alternative under Hypothesis IV must be rejected. In fact, if a two tailed test at the 1 per cent level of significance is used the rate of technical progress in Alberta is significantly less than that in Nova Scotia. Thus this difference is a factor tending to raise the equilibrium wage in Nova Scotia relative to that in Alberta.

Finally, with respect to Hypothesis V a comparison of the calculated t value with the critical t value for any reasonable level of significance indicates that the null hypothesis is not rejected. That is, there appears to be no significant difference between Alberta and Nova Scotia in the elasticity of output with respect to capital.

5.3.4 DIFFERENCES IN SAVING OR CAPITAL FORMATION CONDITIONS

5.3.4 a) Differences in Saving and Investment Out of Gross Regional Output

Given that the growth and level of the equilibrium relative regional wage rate are positively related to the growth of regional capital stock, all other things equal, the equilibrium relative regional wage will be positively related to the proportion of gross regional output which is saved and re-invested in the region. Using this line of reasoning the following hypothesis can be stated.

HYPOTHESIS VI: The higher equilibrium wage in Alberta relative to that in Nova Scotia is at least partially due to a higher proportion of Alberta gross output being re-invested in Alberta relative to the proportion of Nova Scotia gross output re-invested in Nova Scotia. Stated another way, a_1 for Alberta significantly exceeds a_1 for Nova Scotia.

A test of this hypothesis is presented in 5.3.4 c) below.

5.3.4 b) Differences in the Responsiveness of Regional Saving and Investment to Return Differentials

It will be recalled from the analysis undertaken in Chapter IV that the level of the relative equilibrium regional wage is positively related to the responsiveness of interregional capital flows to regional return differentials. On the basis of this it could therefore be argued that the much higher relative equilibrium wage in Alberta compared to that for Nova Scotia wage is related to a greater responsiveness of capital in-flows to return differentials for Alberta compared to Nova Scotia. Alternatively, this argument can be stated as follows:

HYPOTHESIS VII: The higher equilibrium wage in Alberta relative to that in Nova Scotia is at least partially due to a greater responsiveness of regional investment to regional return differentials in Alberta compared to Nova Scotia. Or, in other words, $\hat{a}_2$ for Alberta is significantly greater than $\hat{a}_2$ for Nova Scotia.

It will be recalled that in estimating the capital formation equation for Alberta and Nova Scotia rather poor results were obtained for the coefficient reflecting the responsiveness of investment to return differentials (that is, a_2); the estimated coefficient in both cases was of the wrong sign and insignificant at the 1 per cent level of significance. Nevertheless, for completeness a t test on the differences in this estimated parameter was carried out and is outlined in the following section.

5.3.4 c) Tests of Hypotheses VI and VII

These hypotheses relating to regional differences in saving or capital formation conditions were tested using the dummy variable test procedure outlined above. The equation estimated with the pooled data was:

$$5.3.3 \quad I = a_0 + \gamma_3 D + a_1 Q_{t-1} + \gamma_4 DQ_{t-1} + a_2 RK_{t-1} + \gamma_5 DRK_{t-1} + a_3 I_{t-1} + \gamma_6 DI_{t-1} + e;$$

where $I = m + n$ vector of annual rates of regional investment (m values for Alberta and n values for Nova Scotia), D = dummy variable and is equal to 0 for the m Alberta values and 1 for the n Nova Scotia values, $Q_{t-1} = m + n$ vector of lagged regional output, RK_{t-1} = return to capital in the region relative to that in the nation, lagged one period (defined as in section 5.2.1), and $I_{t-1} = m + n$ vector of lagged annual regional investment.

As before, the coefficients on the dummy variable terms measure regional differences in the coefficients in the investment equations. Specifically, $\gamma_3 = a_{0ns} - a_{0a}$, $\gamma_4 = a_{1ns} - a_{1a}$, $\gamma_5 = a_{2ns} - a_{2a}$ and $\gamma_6 = a_{3ns} - a_{3a}$. The subscripts a and ns distinguish the coefficients for the Alberta and Nova Scotia equations. Thus, the statistical hypotheses can be written as:

HYPOTHESIS VI: $H_0: \gamma_4 = 0$

$H_1: \gamma_4 < 0$

HYPOTHESIS VII: $H_0: \gamma_5 = 0$

$H_1: \gamma_5 < 0$

Equation 5.3.3 was estimated using pooled data and OLS. In this case 2 observations were lost due to the inclusion of the lagged variables leaving a total of 42 observations. These estimates are given in equation 5.3.4 (t ratios are given in brackets).

$$5.3.4 \quad \underset{}{I} = \underset{(1.257)}{1073.326} - \underset{(-.977)}{892.629D} + \underset{(3.709)}{.183Q_{t-1}} + \underset{(.527)}{.112DQ_{t-1}}$$

$$- \underset{(-1.137)}{1048.244RK_{t-1}} + \underset{(.723)}{725.598DRK_{t-1}} + \underset{(2.358)}{.395I_{t-1}}$$

$$- \underset{(-.232)}{.139DI_{t-1}} \qquad R^2 = .990 \quad D.W. = 1.82$$

Given that the critical t value for the 1 per cent level of significance and 42-8 degrees of freedom is 2.44, it is clear that neither of the null hypotheses can be rejected. It is also evident from the relatively small calculated t values that there are no significant regional differences in either the intercept term or the coefficient on lagged investment. On the basis of these estimates it must therefore be concluded that there are no significant differences between Alberta and Nova Scotia in terms of saving or capital formation equations. Thus any explanation of the level of wage inequality between these two regions must involve other factors.

5.3.5 DIFFERENCES IN MIGRATION CONDITIONS

5.3.5 a) Differences in the Response of Migration to Per Capita Income Differences

Within the context of the model presented in Chapter IV the responsiveness of migration to per capita income differences was shown to have an important bearing on the size of the equilibrium relative wage. It has already been demonstrated that for a slow-growth-region (that is, a region which typically has out-migration and a per capita income below the national average) the size of the equilibrium wage differential is negatively related to the response of out-migration to per capita income differences. For a rapid-growth-region on the other hand the size of the equilibrium wage differential is negatively related to the response of in-migration to per capita income differences. On the basis of these results it can be hypothesized that the observed difference between earnings in Alberta and earnings in Nova Scotia is related to this factor in the following way:

HYPOTHESIS VIII: The large degree of wage inequality between Alberta and Nova Scotia is at least partially due to a greater response of migration to per capita income differences in the Alberta case relative to that in the Nova Scotia case. More specifically, the alternative hypothesis is that β_1 for Alberta is significantly greater than $\hat{\beta}_1$ for Nova Scotia.

5.3.5 b) Differences in the Response of Migration to Regional Investment

A final factor which was shown in Chapter IV to be an important determinant of the size of the equilibrium relative wage is the response of interregional migration to the rate of regional investment. There it was demonstrated that for a slow-growth-region the level of the relative equilibrium wage is positively related to the response of migration to the rate of regional investment. For a rapid-growth-region the converse is true. For the cases of Alberta and Nova Scotia these relationships can be stated in the following way.

HYPOTHESIS IX: The large degree of wage inequality between Alberta and Nova Scotia is at least partially due to a lower response of migration to investment in Alberta compared to that in Nova Scotia. The alternative hypothesis is that $|\hat{\beta}_3|$ for Alberta is significantly less than $|\hat{\beta}_3|$ for Nova Scotia.[1]

5.3.5 c) Tests of Hypotheses VIII and IX

Using the dummy variable technique as before the equation which forms the basis of these tests is:

$$5.2.5 \quad M = \beta_0 + \gamma_7 D + \beta_1 LnR + \gamma_8 DLnR + \beta_2 M_{t-1} + \gamma_9 DM_{t-1} + \beta_3 I + \gamma_{10} DI + e;$$

where M = m + n vector regional migration (m values of migration to Alberta and n values of migration from Nova Scotia), D = dummy variable and is 0 for the m Alberta values and 1 for the n Nova Scotia values, R = m + n vector of relative per capita incomes (m values of Alberta per capita income relative to that for Canada, and n values of Canadian per capita income relative to that for Nova Scotia), M_{t-1} = m + n vector of lagged migration, and I = m + n vector of annual regional investment.

In this equation, $\gamma_7 = \beta_{0ns} - \beta_{0a}$, $\gamma_8 = \beta_{1ns} - \beta_{1a}$,

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[1] It will be recalled that the expected sign for β_3 is positive for the case of in-migration (Alberta) and negative for the case of out-migration (Nova Scotia). Thus the relevant comparison is between the absolute values of the parameters.

$\gamma_9 = \beta_{2ns} - \beta_{2a}$ and $\gamma_{10} = \beta_{3ns} - \beta_{3a}$. The subscripts ns and a refer to coefficients for the Nova Scotia and Alberta equations respectively. The statistical hypotheses can be written as:

HYPOTHESIS VIII: $H_0\colon \gamma_8 = 0$

$H_1\colon \gamma_8 < 0$

HYPOTHESIS IX: $H_0\colon |\gamma_{10} + \beta_3| - \beta_3 = 0$

$H_1\colon |\gamma_{10} + \beta_3| - \beta_3 > 0$

In testing these hypotheses it was assumed that the Nova Scotia migration equation estimated with 1961-1971 data most accurately quantifies the long-run determinants of out-migration from Nova Scotia. Hence equation 5.3.5 was estimated using 21 observations for Alberta (one observation is lost by including lagged migration) and 10 observations for Nova Scotia. The estimated coefficients along with the t ratios (in brackets) are given in equation 5.3.6.

$$
\begin{array}{lllll}
5.3.6\quad M = & -24.233 & + 91.560D & + 216.192LnR & - 350.324DLnR \\
 & (-4.336) & (2.047) & (5.151) & (-3.056) \\
 & + .450M_{t-1} & + .596DM_{t-1} & + .010I & - .040DI \\
 & (3.884) & (.891) & (3.371) & (-2.395) \\
 & & & & R^2 = .804 \\
 & & & & D.W. = 1.924
\end{array}
$$

The critical t values for the 1 and 5 per cent levels of significance (and 31-8 degrees of freedom) are 2.51 and 1.72 respectively. A comparison of these values with the calculated t value for the estimated coefficient γ_8 indicates that the null hypothesis under Hypothesis VIII is rejected. Hence it would appear that the level of inequality between Alberta and Nova Scotia in relative wage rates is at least partially due to a lower responsiveness of migration to income differences in the former region relative to that in the latter region.

The test of Hypothesis IX is not quite as straightforward. Although the t value for γ_{10} in equation 5.3.6 indicates that there is a statistical difference, at least at the 5 per cent level, between the coefficients on investment in the two equations this difference is not an absolute difference as required in Hypothesis IX. Given however that the absolute difference is less than the actual difference (.02 versus .04) and the marginal t value, it is probably safe to infer that the statistical difference in the absolute values is insignificant at reasonable levels of significance. For these reasons the null hypothesis under Hypothesis IX is not rejected. Thus, differences in the response of migration to regional investment do not appear to be an important factor in the equilibrium wage differential between Nova Scotia and Alberta. It is also worth noting that there does not appear to be a significant difference (at the 1 per cent level) between these two equations in either the intercept term or the coefficient of partial adjustment.

5.4 GENERAL CONCLUSIONS

In this chapter it was shown that the model of regional wage adjustment presented in Chapter IV was generally supported by the data. Not only did the equations fit the data remarkably well but almost all of hypothesized relationships in the model were statistically significant. The only hypothesis embodied in the model for which there appeared to be no support (at least with present capital stock estimates) was that which argues that interregional capital flows are related to regional differences in the marginal product of labor. It was indicated however that this has no bearing on whether or not the model produces a long-run constancy in regional wage inequality. Rather, its importance lies in its effect on the size of the equilibrium wage differential.

With this evidence it was concluded that the observed constancy in relative wage rates in Alberta and Nova Scotia can be plausibly interpreted as a long-run equilibrium produced by the same interactions and adjustments as embodied in the model. Further, it was indicated that interregional migration in response to per capita income differentials and differentials in the rate of investment is an important part of the adjustment process which has maintained the long-run constancy in wage inequality in spite of large regional differences in rates of development and growth.

On the basis of tests of various hypotheses relating to the level of regional wage inequality it was concluded that the most important factors in explaining the much lower equilibrium wage in Nova Scotia compared to that in Alberta are a lower average level of factor productivity and a lower response of migration to per capita income differences in the case of Nova Scotia compared to the case of Alberta. It was found that other factors such as differences in natural rates of increase of the population, rates of technical progress, elasticities of output with respect to capital, and saving or capital formation conditions were not important in explaining the differences in the relative positions of these two regions.

With respect to the regional differences in the response of migration to per capita income differences it should be noted that the significantly smaller response coefficient not only suggests that the speed of adjustment through migration is slower in Nova Scotia than in Alberta, but also that the implied costs of migration are larger in the case of Nova Scotia compared to the case of Alberta.[1] These two results could be related to numerous factors. The implicit costs of migration could be relatively high for Nova Scotia because the regions offering better income and employment opportunities (for example, Ontario) lie some distance from the region. In the case of Alberta on the other hand a substantial proportion of the migrants are from neighboring regions and thus the costs of migration are relatively low. Some possible explanations for differences between Alberta and Nova Scotia in the implicit costs of migration, the responsiveness of migration to income differences and the average level of factor productivity are discussed in the following chapter.

As a final point it should be noted that although the differences in the elasticity of output with respect to capital and the response of migration to investment were statistically insignificant (at the 1 per cent level) they were of the right signs in terms of explaining the low equilibrium wage in Nova Scotia compared to Alberta.

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[1] Note that the difference in $\hat{\beta}_0$ is not significant (at the 1 per cent level). Given that $e^{-\beta_0/\beta_1} = C$ (where C = costs of migrating) the significantly larger β_1 in Alberta compared to Nova Scotia implies lower migration costs in the Alberta case compared to the Nova Scotia case.

CHAPTER VI

SUMMARY, CONCLUSIONS AND POLICY IMPLICATIONS

6.1 Summary and Conclusions

It was concluded from the analysis of long-run trends in Canadian regional income inequality presented in Chapter II that any levelling in regional inequalities over the period 1926-1971 was slight and that this change was almost entirely due to a steady deterioration in British Columbia's relative per capita income position. Further, it was shown that over the more recent period 1949-1971 the degree of levelling in regional inequality in earned income per capita was less than that in personal income per capita and was largely due to a fall and rise in the respective relative positions of British Columbia and Newfoundland. There have been no significant changes in the relative earned income positions of the remaining provinces.

It was indicated in the summary of existing research on Canadian regional inequality that about three-fifths of the inequalities in per capita income are related to inequalities in wages or earnings per worker and the remaining two-fifths are related to inequalities in employment bases. In Chapter II it was shown that much the same patterns hold with respect to trends in regional inequalities in these two factors as with inequalities in earned income per capita. There has been a constant trend in regional variations in employment bases over the period 1949-1971, and while there has been a slight levelling in regional inequality in earnings per worker it has been almost entirely due to a steady deterioration in British Columbia's above average relative position. The remaining regions, including the special cases of Alberta and Nova Scotia, appear to have maintained relatively stable positions in terms of earnings per worker over this period.

Given these results it was concluded that the trend in Canadian regional income inequality is probably best interpreted as some long-run equilibrium where the individual cases of British Columbia and Newfoundland constitute exceptions. Given this interpretation, the problem set out in this study was to reconcile the lack of change in regional wage inequality (which to a large extent explains the general lack of change in regional income inequality) with the predictions of most economic theory applicable to this area. On the one hand these theories generally predict a tendency for wage rates to be equalized, at least up to some constant representing mobility costs, across regions. Given that this tendency is not observed in Canada it would appear that either the types of adjustments embodied in the theories have not taken place or have taken place but are ineffective. On the other hand however, if the observed trends in regional earnings inequality are explained by a lack of adjustment then there is a problem of explaining how the observed long-run trends have been maintained in spite of the large regional differences in rates of development and growth, and explicit government policies to reduce regional disparities.

It was concluded from the summary of theories applicable to regional economic adjustment that although most of the theories are inadequate in terms of explaining the observed patterns of regional wage inequality, the more complete theories which incorporate both interregional factor and commodity movements generally suggest a pattern of convergence. Perhaps equally important, they suggest that not only do interregional factor movements play a key role in the theory of regional adjustment but also that movements of one factor alone are sufficient to produce convergence.

It was indicated in Chapter III that there are three main shortcomings of existing models of regional adjustment. First, most of the models view regional adjustment in a static framework where there is no natural growth in labor supply and no growth in labor demand. Clearly this framework is unsatisfactory from the point of view of explaining the long-run pattern of adjustment over a period when there was both rapid economic growth and large regional differences in rates of growth and development. Second, most of the models incorporate only one form of adjustment. For example, trade models stress only commodity movements although interregional factor movements are obviously also very important. Third, much of the theory relevant to regional economic adjustment is partial equilibrium theory and as such does not consider simultaneous elements such as the "cause" and "effect" nature of most adjustments.

In Chapter IV a dynamic two-region model of wage adjustment was presented. This more realistic model was designed to take account of the major shortcomings of existing models of regional adjustment. A numerical analysis of the characteristics of this model indicated that it possesses a high degree of stability and generates a steady state equilibrium wage differential that under most conditions exceeds that predicted by static models of regional wage adjustment. This analysis also indicated that the size of the equilibrium differential was particularly sensitive to the responsiveness of interregional migration to per capita income differentials and the rate of real capital formation in the region. Further it was shown that significant shocks to the regional system in the form of increases or decreases in exogenous saving and investment tend to have little effect on the equilibrium wage differential particularly when migration is significantly related to the rate of regional investment and is highly responsive to per capita income differentials. Given these results it was suggested that this model could be used to explain the long-run stability in regional earnings inequality and hence regional income inequality in Canada. While the Canadian trend was interpreted in this study as a long-run constancy rather than a very slow convergence toward some long-run equilibrium, it was indicated that the predictions of the model are also consistent with this latter interpretation.[1]

The model was applied to the regions of Nova Scotia and Alberta and was confirmed to a high degree by the data. The hypothesized relationships in the model generally turned out to be statistically significant and possessed a high degree of explanatory power. On the basis of these results the hypothesis that the observed constancy in relative wage rates in Alberta and Nova Scotia represents a long-run equilibrium produced by the same interactions and adjustments as embodied in the model was accepted.

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[1] See p. 165.

Given that the model was confirmed for the Cases of Alberta and Nova Scotia it was then used to explain the differences in the relative wage positions of these two regions. Eight hypotheses based on the numerical analysis of the model and relating wage inequality to factors such as differences between the two regions in rates of technical progress and the responsiveness of migration to per capita income differentials were set out and tested. On the basis of these tests it was concluded that the much lower relative wage position of Nova Scotia compared to that for Alberta is due to a lower level of factor productivity and a lower responsiveness of migration to per capita income differentials in Nova Scotia compared to Alberta. It was found that other factors such as differences in natural rates of increase of the population, rates of technical progress, elasticities of output with respect to capital, and saving or capital formation conditions were not important in explaining the differences in the relative positions of these two regions.

No attempt was made in this study to isolate the factors which account for the differences in the average level of factor productivity and the responsiveness of migration between the two regions. It is possible that the lower average level of factor productivity in Nova Scotia compared to Alberta is related to such things as differences in the quantity and quality of natural resources, the average scale of economic activity and the quality of the labor force. There will be qualitative differences between the labor inputs in the two regions if there are differences in the age distribution and education of the labor force.

The significantly smaller migration response coefficient for Nova Scotia compared to Alberta not only indicates that the speed of adjustment through migration is slower but also that the implied costs of migration are higher in the former region compared to the latter. The costs associated with out-migration from Nova Scotia may be relatively high because the regions offering better employment and income opportunities (for example, Ontario) lie some distance from the region and thus the actual movement costs will be relatively high. In addition, there may be a lack of information regarding employment and income opportunities. In the case of Alberta on the other hand, a substantial proportion of the migrants to Alberta are from neighboring regions and thus the movement costs will be relatively small and the amount of income and employment information to potential migrants is probably greater than in the case of Nova Scotia.

These differences in migration costs might also be related to differences in opportunity costs. That is, the opportunity costs associated with a move from Nova Scotia to (say) Ontario may be higher than for a move from (say) Saskatchewan or British Columbia to Alberta because a longer search time for employment in the new region is required in the former case compared to the latter. This in turn could be related to differences between potential migrants in Nova Scotia and those in (say) Saskatchewan or British Columbia (who are considering a move to Alberta) in terms of the marketability of their labor skills.

Such an explanation would be consistent with Thirsk's findings regarding Canadian regional differences in structural unemployment.[1]

The differences in the response of migration to per capita income differences in the cases of Alberta and Nova Scotia might also be related to the above types of factors. For example, it may be that since a large proportion of the migrants to Alberta are from neighboring regions, potential migrants in these regions are highly aware of opportunities and are familiar with conditions in Alberta. This familiarity and awareness may be due to both the relatively small geographical distances involved and the existence of contacts with friends and relatives who had earlier moved to the province. In the case of Nova Scotia on the other hand, it may be that the relatively large geographical distances typically involved in migration and the wide dispersion of migrants from the province produce less familiarity with conditions and opportunities in other regions, and a higher level of risk perception. These differences in migration response might also be related to differences between the relevant regions in such factors as industrial structure, cultural heritage and climate.

It should be noted that the differences in factor productivity and the responsiveness of migration to regional per capita income differences between Alberta and Nova Scotia may not be independent. For example, if there was continual out-migration from a region such as Nova Scotia over a long period of time and if it was highly selective with respect to age and education, it could have a significant effect on the quality of the labor force and hence the average level of factor productivity in the region. It would probably be worthwhile to attempt to take account of such effects in future research in this area.

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[1] W. Thirsk, Regional Dimensions of Inflation and Unemployment, p. 89.

6.2 POLICY IMPLICATIONS

It must be stressed at the outset that since this study focused on only part of the problem of regional income inequality any statements regarding policies to reduce regional disparities based on its conclusions can only be of the most general variety. While concentrating on Canadian regional wage inequality, the major factor in Canadian regional income inequality, it did not consider inequalities or adjustments in inequalities in employment bases or possible interactions between wage adjustments and adjustments in employment bases. For example, it ignored any effects which interregional migration through its selective nature might have on regional inequalities in unemployment rates, participation rates and the age distribution of the population.

Given these qualifications, the results of this study may indicate some of the problems with past policies to reduce regional disparities and possible directions for future policies. In particular, this study suggests that any equalization policies involving injections of exogenous saving and investment in low per capita income regions will not likely have any significant effects on the relative per capita income positions of those regions. It appears that while any increase in exogenous investment in the first instance tends to raise the capital-labor ratio and hence the real wage in the region, this increased investment directly and indirectly reduces out-migration from the region.

This tends to increase the growth of the regional labor supply from what it would otherwise be to such an extent that any long-run increase in the relative capital-labor ratio and hence real wage rate is prevented. In a similar manner any withdrawals of exogenous investment from the high per capita income regions reduces in-migration and hence reduces the growth of their labor supplies thereby preventing any reduction in their capital-labor ratios and above average relative wages.

This would thus suggest that in order to be effective any equalization policies involving reallocations of saving and investment among regions must be matched with policies to at least maintain initial levels of interregional labor mobility. These latter policies might involve such things as improvements in the interregional flows of information regarding employment and income opportunities and subsidies for interprovincial movements of labor. The results of this study would also indicate that regional disparities could be reduced solely by policies designed to increase factor mobility without any reallocations of saving and investment. This, however, ignores the possibility of significant backwash effects resulting from increased labor mobility. If further research indicates that this would likely be a problem any policies to stimulate interregional factor movements could probably be designed in such a way to reduce the selectivity of such movements.

The results of this study also suggest that policies of provincial governments designed to increase the rate of economic growth may be self-defeating in terms of raising the level of welfare as measured by per capita income in the region. In the case of Alberta for example, the model would suggest that the large increases in investment associated with development of the tar sands and the petrochemical industry while increasing GDP will also increase the rate of in-migration and hence the provincial population to such an extent that GDP per capita relative to that for Canada is not significantly increased. In fact it may be that the large increase in the population through its effects on such things as housing markets, congestion in urban centres and pollution will cause a fall in the relative level of real welfare. The prediction of the model that rapid economic development will probably not significantly increase the relative per capita income position seems to be borne out by the experience of Alberta in the early 1950's. The rapid development of the province's energy resources at that time produced little or no change in the long-run relative per capita income position of the province. It should be pointed out however, that a policy of rapid regional growth may serve other goals such as reducing the sensitivity of the region to cyclical changes in external markets.

6.3 DIRECTIONS FOR FURTHER RESEARCH

It is hoped that this study is suggestive of the usefulness of numerical analysis in the study of regional inequality. This type of analysis enables one to determine the dynamic characteristics of regional models without sacrificing realism and completeness. The potential of this approach for evaluating the impact of various policies designed to reduce regional disparities and various growth strategies should be apparent.

With this type of analysis in mind there are several directions in which the model used in this thesis might be usefully extended. By disaggregating regional populations and interregional migration by age and education the model might be useful to determine the extent of any backwash effects (that is, unfavorable effects on the education and age structure of the population in the migrant sending regions) associated with interregional migration. It might also be possible to modify the model to take account of agglomeration economies and the effects of interregional migration on these economies. A method of taking these into account has been suggested by Olsen.[1] If in addition to these changes, behavioral equations for regional participation rates and unemployment rates were incorporated in the model it would be extremely useful for policy analysis.

The model could no doubt be improved by using a C.E.S. rather than a Cobb-Douglas production function. The unitary elasticity of factor substitution embodied in the Cobb-Douglas production function may be too restrictive particularly if regional output is disaggregated. With respect to the latter it might be possible through disaggregation to take account of intraregional in addition to interregional factor movements. These types of adjustments, particularly from agricultural to non-agricultural sectors, have been an important element in Canadian regional development.

It might also be useful to apply the model used in this study to other Canadian regions in order to assess the generality of the results obtained here. The model could be applied to the larger regions such as Ontario and Quebec by incorporating feedback effects from the region to the nation. While there are other extensions of and improvements in the model and analysis used in this thesis, they require more data than are currently available.

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[1] E. Olsen, "Regional Income Differences: A Simulation Approach," Regional Science Association Papers, XX, (Hague Conference, 1967), pp. 7-17.

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APPENDIX I

INDEXES OF CANADIAN REGIONAL INEQUALITY

TABLE 1

INDEXES OF REGIONAL DISPERSION OF PERSONAL INCOME PER CAPITA IN CURRENT DOLLARS, 1926-71

YEAR	NINE PROVINCES (Excludes Newfoundland)		TEN PROVINCES	
	Vuw (%)	Auw (%)	Vuw (%)	Auw (%)
1926	24.5	20.8		
1927	25.7	21.9		
1928	24.7	19.7		
1929	26.6	23.2		
1930	28.1	24.2		
1931	32.2	28.3		
1932	30.6	26.9		
1933	32.5	28.6		
1934	31.0	27.2		
1935	28.6	26.3		
1936	29.0	26.2		
1937	29.9	25.5		
1938	28.2	24.6		
1939	25.3	23.0		
1940	26.4	23.6		
1941	30.2	27.0		
1942	25.6	20.0		
1943	26.1	23.8		
1944	23.4	19.0		
1945	22.1	19.6		
1946	19.6	16.0		
1947	21.6	18.0		
1948	23.1	19.2		
1949	22.7	18.3	26.7	21.4
1950	23.8	19.7	27.2	22.6
1951	24.3	19.9	28.1	23.4
1952	23.0	19.5	27.2	22.9
1953	25.2	19.8	28.4	22.7
1954	25.3	21.6	27.9	23.7
1955	25.3	20.8	28.0	23.0
1956	23.1	19.1	26.2	21.7
1957	25.6	21.7	28.0	23.7
1958	24.1	19.8	26.9	22.3
1959	22.6	18.8	25.6	21.3
1960	22.0	17.9	24.9	20.0
1961	23.2	19.6	25.5	21.6
1962	21.1	16.7	24.1	19.0

TABLE 1—Continued

YEAR	NINE PROVINCES (Excludes Newfoundland)		TEN PROVINCES	
	Vuw (%)	Auw (%)	Vuw (%)	Auw (%)
1963	21.4	16.9	24.3	19.2
1964	21.2	18.0	24.1	20.1
1965	21.2	17.7	23.6	19.6
1966	20.9	17.0	23.3	19.0
1967	20.7	17.2	22.9	19.1
1968	19.9	16.3	22.2	18.3
1969	20.8	17.5	22.7	18.4
1970	20.6	17.6	22.3	19.1
1971	19.8	16.7	21.6	18.3

Source: Calculated from data in Statistics Canada, National Accounts Income and Expenditure, 1971 (Ottawa: Queen's Printer, 1971).

Note: The measures Vuw and Auw are defined in Section 2.2.2.

DOMTAR
CELL-FAST BOND
50% COTTON

TABLE 2

PERSONAL INCOME PER CAPITA AS A PER CENT OF THE NATIONAL AVERAGE FOR NINE PROVINCES (EXCLUDES NEWFOUNDLAND), 1926-71

YEAR/PROV.	P.E.I.	N.S.	N.B.	QUE.	ONT.	MAN.	SASK.	ALTA.	B.C.
1926	56.2	67.8	64.8	84.6	114.5	108.4	101.9	113.8	122.1
1927	57.0	67.3	62.2	84.9	115.3	94.4	100.9	125.9	121.2
1928	53.4	69.2	62.8	85.9	115.4	103.8	100.2	106.8	122.4
1929	58.7	71.8	64.5	91.2	122.4	97.4	66.5	92.5	129.0
1930	52.8	73.7	65.3	91.6	123.7	98.6	61.4	90.0	129.2
1931	51.4	76.0	67.2	94.9	128.0	90.7	44.9	78.0	129.9
1932	50.2	74.9	63.9	93.5	125.8	95.9	55.3	80.4	130.2
1933	49.8	78.7	65.2	93.6	128.1	94.0	47.6	73.8	132.2
1934	48.3	75.7	63.2	92.2	126.7	94.3	53.7	82.8	128.0
1935	55.6	77.6	64.2	90.7	126.8	90.1	62.9	79.2	130.0
1936	55.6	79.6	67.5	92.1	125.5	92.4	58.1	76.3	131.9
1937	58.4	79.6	67.1	90.8	125.5	104.9	44.3	90.2	129.6
1938	54.6	78.4	64.3	89.2	124.6	91.6	59.2	95.1	129.7
1939	57.8	76.7	64.2	87.8	123.8	91.5	76.7	88.1	125.6
1940	53.1	77.6	65.2	85.8	125.6	91.5	70.9	91.3	122.7
1941	46.9	77.7	64.0	86.6	129.5	92.8	59.3	80.0	120.9
1942	48.2	76.1	60.8	81.4	120.5	91.6	100.2	102.3	115.7
1943	52.3	80.4	65.4	83.7	123.5	91.5	74.5	83.7	122.0
1944	52.5	79.6	64.9	79.9	119.2	91.7	104.2	96.4	112.7
1945	57.9	81.2	70.6	80.8	120.9	93.6	83.9	91.6	115.5
1946	58.2	85.9	75.2	81.5	115.7	103.0	96.1	107.8	114.9
1947	55.0	79.9	71.8	85.3	111.4	101.7	88.3	106.4	117.3
1948	53.7	71.9	68.9	84.9	115.6	105.9	95.6	109.4	116.9
1949	54.8	73.5	68.5	84.0	117.7	102.1	95.5	104.1	117.1
1950	54.4	73.5	69.3	84.9	119.8	100.2	82.3	99.3	120.8
1951	53.8	68.3	66.2	82.9	116.8	99.6	105.8	109.6	117.7
1952	59.9	71.0	64.0	83.9	115.6	96.9	110.5	106.5	118.7
1953	48.3	72.1	63.0	85.5	116.7	93.9	99.2	105.1	118.8
1954	52.4	75.7	66.5	87.9	118.9	93.3	72.4	97.6	121.4
1955	48.9	73.0	65.3	85.5	118.2	93.4	88.0	98.7	122.0
1956	58.0	71.1	65.0	85.3	116.5	95.9	92.4	103.4	119.9
1957	50.8	73.2	64.6	87.1	118.4	92.7	76.9	98.2	120.2
1958	52.6	73.4	65.0	86.0	117.7	98.0	82.2	103.0	114.8
1959	58.6	74.9	66.3	85.8	117.7	98.1	81.5	100.6	115.8
1960	56.3	75.7	67.4	86.3	116.7	98.5	88.4	98.9	114.2
1961	58.3	77.1	67.4	89.4	117.4	93.5	70.4	99.2	113.9
1962	59.8	74.9	65.7	88.4	115.8	96.7	92.4	98.9	111.0
1963	57.8	74.8	66.4	87.8	116.1	93.5	97.3	97.3	111.2

TABLE 2--Continued

YEAR/PROV.	P.E.I.	N.S.	N.B.	QUE.	ONT.	MAN.	SASK.	ALTA.	B.C.
1964	60.2	75.3	67.9	89.5	116.3	94.9	83.8	95.2	112.3
1965	59.6	74.1	67.9	89.2	115.6	93.0	89.3	96.2	112.8
1966	59.6	74.2	68.3	88.5	115.4	91.2	92.3	99.3	110.7
1967	61.6	76.1	68.8	89.8	115.3	94.7	80.7	98.4	110.0
1968	63.4	76.0	69.8	88.3	116.0	95.8	84.0	99.5	107.5
1969	61.9	76.5	69.9	87.6	117.0	93.0	79.9	99.3	108.8
1970	66.1	77.4	71.8	88.4	117.2	92.2	71.7	99.0	107.3
1971	63.8	76.1	72.0	88.2	115.6	93.4	81.0	99.2	108.4

Source: Based on data from Statistics Canada, National Accounts Income and Expenditure , 1971 (Ottawa: Queen's Printer, 1971).

TABLE 3

PERSONAL INCOME PER CAPITA AS A PER CENT OF THE NATIONAL AVERAGE FOR TEN PROVINCES, 1949-71

YEAR/PROV.	NFLD.	P.E.I.	N.S.	N.B.	QUE.	ONT.	MAN.	SASK.	ALTA.	B.C.
1949	50.9	55.5	74.5	69.4	85.1	119.2	103.4	96.8	105.4	118.7
1950	51.0	55.1	74.4	70.2	85.9	121.2	101.4	83.3	100.6	122.3
1951	48.3	54.5	69.2	67.1	84.0	118.3	100.9	107.2	111.1	119.2
1952	47.6	60.7	71.9	64.8	84.9	117.1	98.0	111.9	107.4	120.2
1953	50.8	48.9	73.0	63.7	86.5	118.0	95.0	100.4	106.3	120.2
1954	53.4	53.0	76.5	67.2	88.9	120.2	94.4	73.2	98.7	122.7
1955	53.1	49.5	73.8	66.0	86.6	119.5	94.4	89.0	99.8	123.3
1956	53.5	58.7	72.0	65.8	86.2	117.8	97.0	93.5	104.6	121.2
1957	54.5	51.3	73.9	65.3	88.1	119.6	93.6	77.8	99.2	121.5
1958	53.6	53.2	74.1	65.7	87.0	118.9	99.0	83.2	104.1	116.1
1959	54.0	59.1	75.6	66.9	86.7	118.9	99.0	82.3	101.6	117.0
1960	55.5	56.9	76.4	68.1	87.2	117.8	99.4	89.2	99.8	115.3
1961	58.2	58.9	77.8	68.0	90.2	118.4	94.4	71.0	100.0	115.0
1962	56.0	60.4	75.6	66.2	89.1	116.9	97.6	93.2	99.8	112.0
1963	56.3	58.4	75.5	67.0	88.6	117.2	94.3	98.2	98.2	112.3
1964	56.9	60.8	75.9	68.5	90.3	117.3	95.8	84.5	96.0	113.3
1965	59.2	60.1	74.7	68.4	89.9	116.5	93.8	90.1	97.0	113.7
1966	59.9	60.2	74.8	68.9	89.2	116.4	91.9	93.1	100.1	111.6
1967	61.0	62.1	76.7	69.3	90.5	116.2	95.4	81.3	99.1	110.8
1968	61.5	63.9	76.6	70.4	89.0	117.0	96.6	84.7	100.3	108.4
1969	61.1	62.4	77.1	70.5	88.3	118.0	93.8	80.6	100.2	109.7
1970	63.9	66.6	77.9	72.3	89.1	118.2	92.9	72.3	99.7	108.1
1971	64.9	64.2	76.7	72.5	88.9	116.5	94.1	81.6	100.0	109.2

Source: Based on data from Statistics Canada, National Accounts Income and Expenditure, 1971 (Ottawa: Queen's Printer, 1971).

TABLE 4

INDEXES OF REGIONAL DISPERSION OF EARNED INCOME PER CAPITA, BASED ON TEN PROVINCES, 1949-71

YEAR	Auw (%)	Vuw (%)	YEAR	Auw (%)	Vuw (%)
1949	22.7	27.8	1961	24.3	28.8
1950	24.0	28.9	1962	21.6	27.8
1951	25.5	30.3	1963	21.8	28.0
1952	24.9	29.5	1964	22.6	27.5
1953	24.9	30.7	1965	22.0	27.2
1954	25.3	30.0	1966	21.7	27.5
1955	24.8	30.2	1967	22.3	27.5
1956	23.2	28.4	1968	21.5	26.6
1957	25.8	30.6	1969	22.5	27.1
1958	25.0	30.3	1970	22.3	26.4
1959	23.8	28.9	1971	21.4	25.7
1960	22.7	28.6			

Source: Based on data from Statistics Canada, *National Accounts Income and Expenditure*, 1971 (Ottawa: Queen's Printer, 1971).

TABLE 5

EARNED INCOME PER CAPITA RELATIVE TO THE CANADIAN AVERAGE,

BY PROVINCE, 1949-1971

YEAR/PROV.	NFLD.	P.E.I.	N.S.	N.B.	QUE.	ONT.	MAN.	SASK.	ALTA.	B.C.
1949	50.4	52.5	70.1	66.9	84.7	120.9	105.6	98.9	107.7	115.9
1950	49.3	51.0	69.2	67.8	85.2	123.5	101.7	85.4	102.0	121.1
1951	46.4	48.7	65.0	64.7	83.7	119.2	102.8	112.8	113.3	115.4
1952	45.9	56.9	66.3	61.8	84.8	117.3	99.6	119.0	110.6	117.8
1953	49.1	43.5	66.6	60.4	86.3	119.2	96.3	105.7	108.7	117.3
1954	52.4	48.7	69.5	62.9	89.2	122.1	95.0	73.3	99.5	120.8
1955	52.3	45.1	67.0	61.0	86.8	121.3	94.3	89.6	100.6	121.9
1956	52.1	55.0	64.7	61.1	86.4	119.5	96.6	96.5	106.2	118.8
1957	53.1	46.6	66.3	59.6	88.3	122.2	93.1	77.7	98.7	119.4
1958	50.1	47.2	66.3	59.7	87.1	122.0	98.4	81.6	104.2	113.8
1959	51.2	53.1	66.8	61.1	87.4	120.9	99.1	81.9	102.7	115.4
1960	53.3	48.8	68.0	61.8	87.9	120.1	98.9	88.2	100.3	113.9
1961	56.0	52.6	69.0	62.7	90.5	121.1	93.4	68.5	101.6	113.5
1962	53.4	51.6	66.8	61.5	89.8	119.1	96.9	93.9	100.1	110.3
1963	54.0	49.6	66.0	62.0	89.5	119.0	93.3	102.0	98.7	109.9
1964	54.9	52.6	66.7	63.7	91.2	119.4	95.3	84.5	95.8	111.5
1965	55.6	52.7	66.3	63.6	90.5	118.5	93.2	91.3	97.5	112.3
1966	55.5	50.5	65.9	63.5	90.5	118.1	90.3	94.9	100.0	110.3
1967	55.4	51.5	67.3	64.4	91.8	118.1	94.5	81.4	98.6	110.1
1968	56.1	54.1	67.9	64.5	89.6	119.0	96.1	84.6	101.3	107.6
1969	56.2	53.1	69.4	65.4	88.6	120.1	93.2	79.4	100.8	109.0
1970	59.0	58.0	71.0	67.8	89.2	120.6	91.7	68.8	101.0	106.9
1971	58.8	55.1	70.0	68.3	88.4	118.9	93.5	80.2	100.5	109.0

Source: Based on data from Statistics Canada, National Accounts Income and Expenditure, 1971 (Ottawa: Queen's Printer, 1971).

TABLE 6

INTERREGIONAL DISPERSION OF EMPLOYMENT BASES, 1949-1971

YEAR	EMPLOYMENT BASE BY REGION (%)						Vuw
	Can.	Atl.	Que.	Ont.	Pr.	B.C.	(%)
1949	36.5	25.8*	35.4	40.5	37.8	37.9	14.3*
1950	36.3	30.2	34.5	39.9	37.0	36.1	9.0
1951	36.4	30.3	35.0	40.0	36.6	35.7	8.9
1952	35.8	29.0	34.7	39.0	36.2	35.6	9.5
1953	35.3	28.5	34.7	38.6	35.0	34.6	9.7
1954	34.3	27.4	33.5	38.0	33.6	33.7	10.3
1955	34.2	27.5	33.1	37.8	33.4	34.4	10.1
1956	34.7	27.7	33.2	38.8	34.2	35.0	10.7
1957	34.5	27.5	33.0	38.3	34.1	34.3	10.5
1958	33.4	25.9	32.3	36.8	34.1	32.6	11.2
1959	33.6	26.2	32.2	36.8	34.4	33.2	11.0
1960	33.4	26.4	31.9	36.8	34.4	32.2	10.8
1961	33.2	26.7	31.4	36.4	34.6	32.4	10.3
1962	33.5	26.8	31.9	36.5	34.9	33.2	10.2
1963	33.7	26.9	32.1	36.8	34.6	33.6	10.2
1964	34.3	27.7	32.7	37.3	34.9	34.7	9.7
1965	34.9	28.8	33.6	37.5	35.5	35.6	8.7
1966	35.7	29.7	34.9	38.1	36.1	36.2	8.2
1967	36.2	29.8	35.5	38.5	36.3	37.2	8.5
1968	36.4	29.7	35.1	39.0	37.0	37.4	9.1
1969	37.0	29.8	35.6	39.8	37.5	38.6	9.7
1970	37.0	29.9	35.7	39.7	37.5	38.1	9.4
1971	37.5	30.0	36.4	40.0	37.8	38.8	9.7

Source: Based on data in Dominion Bureau of Statistics (Statistics Canada), The Labour Force, various years (Ottawa: Queen's Printer), Cat. 71-001 and Dominion Bureau of Statistics (Statistics Canada), Vital Statistics, various years (Ottawa: Queen's Printer), Cat. 84-202.

*Newfoundland not included prior to October 1949.

TABLE 7

INTERREGIONAL DISPERSION OF EARNED INCOME PER WORKER, 1949-1971

YEAR	EARNED INCOME PER WORKER AS A PERCENTAGE OF THAT FOR CANADA					Vuw
	ATL.	QUE.	ONT.	PR.	B.C.	(%)
1949	90.2*	87.3	109.0	100.6	111.7	9.7*
1950	75.9	89.5	112.4	94.5	121.5	16.3
1951	71.6	87.0	108.5	109.2	117.6	16.9
1952	73.6	87.4	107.6	108.5	118.3	16.2
1953	73.4	87.8	108.9	104.9	119.5	16.3
1954	77.9	91.3	110.1	91.7	122.8	15.8
1955	74.9	89.7	109.5	97.3	121.0	15.9
1956	75.2	90.5	107.0	101.9	118.1	14.7
1957	75.1	92.2	110.0	91.7	120.0	15.7
1958	76.5	90.2	110.7	93.8	116.8	14.6
1959	77.7	91.0	110.3	93.1	116.5	14.1
1960	77.8	92.1	108.9	93.6	118.0	14.1
1961	78.3	95.6	110.5	86.0	116.4	14.6
1962	76.3	94.3	109.4	93.5	111.3	13.1
1963	76.4	93.7	109.0	95.4	110.1	12.6
1964	76.8	95.5	109.7	90.8	110.2	12.9
1965	75.3	94.0	110.2	92.9	110.3	13.4
1966	74.3	92.7	110.8	94.7	109.0	13.6
1967	75.9	93.7	111.0	92.4	107.3	13.0
1968	77.4	92.8	111.1	93.6	104.6	12.2
1969	74.3	92.1	111.9	91.6	104.7	11.9
1970	82.0	92.5	112.4	88.6	103.9	11.6
1971	82.1	90.9	111.4	92.4	105.3	11.1

*Newfoundland is not included prior to October 1949.

Source: Based on Data from Statistics Canada, National Accounts Income and Expenditure, 1971 (Ottawa: Queens Printer, 1971) and Dominion Bureau of Statistics (Statistics Canada), The Labour Force, various years (Ottawa: Queen's Printer), Cat. 71-001.

TABLE 8

EARNINGS PER WORKER AND EMPLOYMENT BASES IN ALBERTA AND NOVA SCOTIA AS A PERCENTAGE OF THOSE FOR CANADA, 1950-1971.

YEAR	RELATIVE EARNINGS PER WORKER (%)		RELATIVE EMPLOYMENT BASE (%)	
	ALBERTA	NOVA SCOTIA	ALBERTA	NOVA SCOTIA
1950	109.0	75.6	93.6	91.6
1951	111.8	70.7	101.3	91.9
1952	104.8	68.5	105.5	96.8
1953	102.1	67.1	106.5	99.2
1954	103.0	69.4	96.5	100.0
1955	94.0	67.4	107.0	99.4
1956	94.1	66.5	112.8	97.4
1957	96.7	68.3	102.1	97.2
1958	100.0	68.0	104.2	97.5
1959	101.7	68.9	100.9	96.9
1960	101.9	70.8	98.4	96.0
1961	97.7	73.7	104.0	93.6
1962	98.7	73.2	101.4	91.2
1963	96.2	74.3	102.7	89.0
1964	96.5	75.7	99.3	88.1
1965	94.6	75.1	103.1	88.2
1966	93.3	77.8	107.1	87.0
1967	94.3	79.3	104.5	86.5
1968	95.3	81.7	106.3	85.6
1969	94.8	83.5	106.3	85.0
1970	96.7	83.5	104.4	85.0
1971	94.9	84.7	105.8	82.6

Source: Based on Data from Statistics Canada, National Accounts, Income and Expenditure, 1971, (Ottawa: Queens Printer, 1971), Statistics Canada, Vital Statistics, various years, (Ottawa: Queens Printer, Cat. 84-202) and Dominion Bureau of Statistics (Statistics Canada), The Labour Force, various years (Ottawa: Queen's Printer), Cat. 71-001. For provincial employment estimates prior to 1966 see Chapter V.

APPENDIX II

THE METHODOLOGY FOR ESTIMATING REGIONAL CAPITAL STOCKS

Since the aggregate regional capital stock figures required in this study do not presently exist, they had to be estimated. It was also necessary to estimate the national capital stock for the period 1951-1971 since the currently available estimates do not cover the period beyond 1955.[1]

There are basically three methods which can be used to estimate regional capital stocks. These are: (i) Adding balance sheet asset figures, (ii) the Capitalization method, and (iii) the Cumulation or Perpetual Inventory method. Given existing data limitations however, the latter method appears to have the potential of producing the best estimates. Not only is some of the data required in the first two methods currently unavailable, but also much of the available data is quite unreliable.[2] The Cumulation method has been the commonly used method for estimating capital stocks in Canada.[3]

An application of the cumulation method to estimating regional capital stocks requires data on investment expenditures and estimates of the service lives of the assets used by various sectors in the various regions. Data on construction and machinery and equipment capital expenditures by province are currently available for the period 1951-1973.[1] On the assumption that the prices of capital goods are equalized across regions these figures can be deflated by the national capital formation price indexes for construction and machinery and equipment[2] to get a series for real construction investment (I_c) and for real investment in machinery and equipment (I_m).

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[1] Estimates of capital stocks for Canada by industry and sector for the period 1926-1955 are available in William C. Hood and Anthony D. Scott, Output, Labour and Capital in the Canadian Economy, a study published by the Royal Commission on Canada's Economic Prospects (Ottawa: 1957) see chapter 6, Appendix B.

[2] For a discussion of the three estimation procedures along with underlying assumptions and the problems in applying them, see ibid., pp. 231-237.

[3] For applications of the method see Hood and Scott, Output, Labour and Capital in the Canadian Economy, and DBS, Fixed Capital Flows and Stocks, Manufacturing, Canada, 1926-1960: Methodology. (Ottawa: Queens Printer, 1967) cat. 13-522. This method has also been used to estimate the capital stock for Nova Scotia. See Stan Czamanski, Regional Science Techniques in Practice, (Toronto: D.C. Heath and Company, 1972) pp. 243-262. See also Camu, Weeks and Sametz, Economic Geography of Canada, pp. 102-103.

Now if straight line depreciation is assumed and if it is further assumed that the average expected life of capital of type c (construction) is β years and the average expected life of capital of type m (machinery and equipment) is γ years, the net real capital accumulation between the year 1951 and any year t ($t > 1951$) can be represented by NKA_t where:

$$2.1 \quad NKA_t = [Ic_t + (1 - 1/\beta)\, Ic_{t-1} + \ldots + (1 - \frac{t-1951}{\beta})\, I_{c,1951}]$$

$$+ [I_{mt} + (1 - 1/\gamma)\, I_{ct-1} + \ldots + (1 - \frac{t-1951}{\gamma})\, I_{m,1951}]$$

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[1] These are found in Information Canada, Private and Public Investment in Canada, Outlook and Regional Estimates, various years (Ottawa: Queens Printer).

[2] These indexes were computed using the current and constant 1961 figures for construction and machinery and equipment capital formation in Canada. These figures are given in, Information Canada, Private and Public Investment in Canada, Outlook and Regional Estimates, (Ottawa: Queens Printer) various years, section 1.

If data on regional investment were available for a sufficiently long period of time prior to 1951, the procedure outlined in equation 2.1 could be used to estimate capital stocks for the period 1951-1971. Since this data does not exist it is necessary to estimate the capital stock accumulated prior to 1951 which is in place in 1951. An estimate of this base capital stock can be derived if it is assumed that regional production technology is described by a Cobb-Douglas production function exhibiting constant returns to scale. In this case it can be shown that the average capital-output ratio is equal to the marginal capital-output ratio multiplied by the elasticity of output with respect to capital. That is,

2.2 $K/Q = \alpha\,(dK/dQ)$; where K = capital, Q = output and α = the elasticity of output with respect to capital. Under these conditions the real gross regional capital stock can be estimated from:

2.3 $K_{1951} = \alpha\left(\frac{\Delta K}{\Delta Q}\right) \cdot Q_{1951} = \alpha\,(I/\Delta Q) \cdot Q_{1951}$; where I = real gross regional capital formation, and Q = real gross regional output. In applying this procedure, an average marginal capital-output ratio was used in order to remove any short-run fluctuations in the marginal capital-output ratio. The actual ratio used was,

$$2.4 \quad \frac{\Delta K}{\Delta Q} = \frac{I_{1951} + \ldots + I_{1960}}{Q_{1960} - Q_{1950}}$$

In estimating the base capital stocks for Alberta and Nova Scotia, real Gross Regional Product (in millions of 1961$) and real gross regional investment ($I_c + I_m$, in millions of 1961$) were used. The estimates for α for the two regions were based on earned income as a proportion of gross regional output, where earned income was taken as a proxy for labor's share of output. The base capital stock used in estimating capital stocks for Canada was Hood and Scott's estimate for aggregate capital stock in 1951,[1] converted to constant 1961 dollars.

If straight-line depreciation is applied to the base year capital stock, the total regional capital stock in place in any year t (where $t > 1951$) will be given by,

2.5 $K_t = [\, K_{1951} - ((1-\Gamma)\, K_{1951} \cdot (t-1951))] + NKA_t$; where NKA_t is as defined in equation 2.1 and Γ is the inverse of the average life of the 1951 capital stock. Γ can be estimated by applying the average relative proportions of total investment in the form of construction and machinery and equipment for the 1951-1971 period as weights to the assumed lives of these types of capital.

A problem which arises in using this procedure to estimate regional capital stocks is the estimation of the useful lives of the various types of capital. One possible route which could be taken here is to base these estimates on those used by Hood and Scott.[2] Using this approach it would be reasonable to set $\beta = 50$ years and $\gamma = 25$ years. These in turn would imply an average life of about 40 years for the capital stock in Alberta and Nova Scotia.[1]

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[1] Hood and Scott, *Output, Labour and Capital in the Canadian Economy*, pp. 444 and 450. The figure used was total industry capital stock plus total social capital stock.

[2] ibid., chapter 6, Appendix C.

Although the applications of the Cumulation method to estimating Canadian capital stocks have generally involved straight-line depreciation, there is both theoretical and empirical support for exponential decay depreciation. Jorgenson[2] for example cites a theorem in renewal theory which indicates that replacement will be proportional to the accumulated capital stock independent of individual equipment replacement patterns provided that the capital stock is constant or growing at a constant rate. In addition, Meyer and Kuh[3] found that there were no significant "echo effects" in U.S. investment flows. That is no "bunching" at regular intervals followed high levels of investment.

For these reasons, the capital stock estimates used in this study were derived on the basis of an exponential decay rate depreciation pattern. Using the base capital stocks estimated above, the regional capital stock in period t (where $t > 1951$) was found by applying,

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[1] For example, over the post-war period I_c and I_m accounted for about 69 and 31 per cent respectively of total real capital expenditures in Alberta.

[2] Dale W. Jorgenson, "The Theory of Investment Behavior," in National Bureau of Economic Research, Determinants of Investment Behavior, (New York: Columbia University Press, 1967) pp. 129-155.

[3] J.R. Meyer and E. Kuh, The Investment Decision (Cambridge: Harvard University Press, 1957).

2.6 $K_t = K_{t-1}(1-d) + I_{mt} + I_{ct}$

In deriving the capital stock estimates for Canada, Alberta and Nova Scotia, d, the annual rate of depreciation, was set equal to 8 per cent. This rate is consistent with the appropriately weighted average of the rates estimated by Evans and Helliwell[1] and with average lives of 50 and 25 years respectively for capital of type c and m respectively.[2]

The estimated capital stocks for Canada, Alberta and Nova Scotia which were used in this study are set out in Table 2.1 below. While it must be emphasized that these are only rough estimates, they nevertheless compare quite favorably with other estimates based on slightly different estimation procedures. For example, the 1955 capital stock figure for Canada is very close to Hood and Scott's estimate for that year[3] and the figure for the 1961 capital stock in Nova Scotia is very close to Czamanski's estimate for the same year.[4]

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[1] R.G. Evans and J. Helliwell, Quarterly Business Capital Expenditures, Bank of Canada Staff Research Study No. 1 (1969), pp. 23-24.

[2] These values imply a weighted average life of about 40 years. With an annual rate of depreciation of 8 per cent, approximately 95 per cent of a given capital stock is depreciated by the 40th year.

[3] Hood and Scott, Output Labour and Capital in the Canadian Economy, pp. 444 and 450. Their estimates for net industry capital stock and net social capital stock for 1955 imply an aggregate capital stock of 46,892.9 millions of 1949 dollars or 63,799.9 millions of 1961 dollars.

[4] Czamanski, Regional Science Techniques in Practice, pp. 251 and 256. His estimate of the total net capital stock in Nova Scotia in 1961 is 2254.4 millions of 1961 dollars (includes capital in the form of residential housing).

TABLE 9

ESTIMATED AGGREGATE CAPITAL STOCKS FOR CANADA, ALBERTA AND NOVA SCOTIA, 1951-1971 (in millions of 1961$)

Year	Canada	Alberta	Nova Scotia
1951	50,787.5	5325.2	1649.5
1952	52,797.5	5572.5	1667.0
1953	55,255.7	5942.5	1710.1
1954	57,293.2	6160.9	1747.2
1955	59,777.8	6455.6	1785.4
1956	63,434.6	6864.9	1831.2
1957	67,303.8	7159.8	1875.8
1958	70,553.5	7493.4	1914.6
1959	73,477.2	7846.4	1988.7
1960	75,880.0	8160.9	2062.7
1961	78,101.6	8489.0	2121.7
1962	80,485.5	8732.1	2171.5
1963	83,066.7	8987.5	2222.0
1964	86,674.3	9297.3	2296.2
1965	91,255.4	9724.9	2394.9
1966	96,755.0	10271.4	2553.8
1967	102,026.0	10861.8	2742.7
1968	106,743.9	11423.0	2907.3
1969	111,764.4	12036.0	3113.6
1970	116,663.2	12575.1	3334.4
1971	121,752.2	13088.6	3521.2

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APPENDIX III

ESTIMATES OF ANNUAL MIGRATION FOR ALBERTA AND NOVA SCOTIA, 1950-1971.

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TABLE 10

ESTIMATES OF ANNUAL MIGRATION FOR ALBERTA AND NOVA SCOTIA, 1950-1971

(in thousands of migrants from June
1 of year t-1 to June 1 of year t)

YEAR	ALBERTA	NOVA SCOTIA
1950	6.8	-6.2
1951	13.4	-1.7
1952	16.4	-2.3
1953	20.3	-2.8
1954	7.8	-3.1
1955	5.3	-1.2
1956	13.7	-7.4
1957	14.1	-5.1
1958	13.0	-2.7
1959	13.2	-4.8
1960	10.9	-3.1
1961	7.2	-4.2
1962	4.7	-7.9
1963	-2.1	-8.3
1964	-4.2	-10.2
1965	-9.2	-9.6
1966	6.0	-4.3
1967	13.2	- .5
1968	14.5	.9
1969	14.7	- .1
1970	11.9	- .5
1971	7.7	-2.2

Source: Estimated with the procedure outlined in Chapter V, section 5.2.2 and data from Dominion Bureau of Statistics (Statistics Canada), Vital Statistics, various years, (Ottawa: Queens Printer, CAT. 84-202).